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A Guide to the Response of Common Plants in British Columbia to Management Treatments

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A Guide to the Response of Common Plants in British Columbia to Management Treatments

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Mention of specific treatments, compounds, or trade names neither constitutes recommendations for their use nor excludes the possibility that other products or treatments may be equally or more effective.

Persons involved in the preparation and publication of this report assume no responsibility for any results or consequences that arise from the use of treatments and products mentioned in the report.

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1 INTRODUCTION

Successful vegetation management rests on the managers having a basic understanding of the ecological characteristics of individual plant species. In this guide, the important autecological characteristics of 35 common plants are summarized and information about how they respond to various management practices is provided.

Vegetation management must be carried out with consideration for various resource uses. Competition from shrubs and herbs can be a serious impediment to the establishment of conifer trees. Control of competing species may be required. Complete eradication of competitors from a site is rarely necessary. Some plant species, such as the nitrogen-fixing alders, may benefit conifers; other species may impede crop tree growth for the entire length of the rotation. Many plants are of great value to wild animals for food, cover, and nesting. The guide contains valuable information for those whose goal is to manage vegetation to meet a variety of objectives.

The information provided here is not referenced. It has been gathered from a variety of published and unpublished sources, and through conversations with researchers and practitioners in vegetation management and related fields. Most of the statements can be traced to their source in the literature review entitled *"Autecology of Common Plants in British Columbia: A Literature Review"*,[1] which was prepared as a companion publication to this guide.

[1] S. Haeussler and D. Coates. 1990. Autecology of common plants in British Columbia: a literature review. B.C. Min. For., FRDA Report 158. Revised by J. Mather 1990.

2 ABBREVIATIONS FOR BIOGEOCLIMATIC ZONES AND SUBZONES

In this guide the B.C. Ministry of Forests' biogeoclimatic classification is used to describe ecosystems where the plants occur within the province. The abbreviations of biogeoclimatic zones are in Table 1, and the subzone abbreviations are in Table 2.[2,3]

TABLE 1. Abbreviations for biogeoclimatic zones

Abbreviation	Biogeoclimatic zone
AT	Alpine Tundra
BG	Bunchgrass
BWBS	Boreal White and Black Spruce
CDF	Coastal Douglas-fir
CWH	Coastal Western Hemlock
ESSF	Engelmann Spruce–Subalpine Fir
ICH	Interior Cedar–Hemlock
IDF	Interior Douglas-fir
MS	Montane Spruce
MH	Mountain Hemlock
PP	Ponderosa Pine
SWB	Spruce–Willow–Birch
SBS	Sub-Boreal Spruce
SBPS	Sub-Boreal Pine–Spruce

TABLE 2. Codes for biogeoclimatic subzones

Relative precipitation regime		Relative air temperature regime	
Abbreviation	Class	Abbreviation	Class
x	Very dry	h	Hot
d	Dry	w	Warm
m	Moist	m	Mild
w	Wet	k	Cool
v	Very wet	v	Very cool

[2] Pojar, J. (editor). 1983. Forest ecology. *In* Forestry handbook for British Columbia. 4th ed. S.B. Watts (editor). D.W. Friesen and Sons Ltd., Cloverdale, B.C., pp. 221–318.

[3] D. Lloyd, K. Angove, G. Hope, and C. Thompson. 1990. A guide to site identification and interpretation for the Kamloops Forest Region. B.C. Min. For., Victoria, B.C., Land Mgmt. Handb. No. 23.

3 AUTECOLOGY OF COMMON PLANT SPECIES

Plant autecology is the study of the adaptations and behaviour of individual plant species or populations in relation to their environment. Most foresters are already familiar with the subject of autecology as it relates to tree species, termed "silvics."

Tables 3–5 summarize autecological information for each of the plant species included in this guide. Table 3 provides information about the distribution and habitat preferences of each species, while Tables 4 and 5 summarize the plants' physical attributes and reproductive characteristics. The information is condensed from the companion literature review describing the autecology of these species. Readers are recommended to refer to the literature review for more detailed information about the plant species in this guide.

TABLE 3. Distribution and habitat of selected species

Species	Biogeoclimatic zones	Habitat conditions	Shade tolerance
Acer circinatum (vine maple)	Mainly in CDF, CWH, and IDF.	Variable. Prefers rich, moist sites. Flood tolerant.	Very high
Acer glabrum (Douglas maple)	Abundant in IDF and drier ICH subzones.	Dry to moist sites. Often on rocky soils.	Moderate
Acer macrophyllum (bigleaf maple)	Occurs only in CDF, CWH, and IDF.	Variable. Mostly moist, rich sites.	Low to moderate
Alnus incana ssp. *tenuifolia* (mountain alder)	Occurs throughout all Interior zones but is only locally abundant.	Moist to wet rich sites.	Moderate (high)
Alnus rubra (red alder)	Abundant in CWH and CDF. Occurs at low elevations in the MH zone.	Prefers disturbed and alluvial soils.	Low
Alnus viridis (Sitka or green alder)	Green: Mainly in BWBS and SWB. Sitka: All zones except PP and BG.	Green: Harsh boreal habitats. Sitka: Cool moist habitats. Very frost tolerant.	Moderate (high)
Athyrium filix-femina (lady fern)	Most abundant in wet ICH and CWH zones and SBSvk subzone. Rare in dry areas of southern Interior.	Moist to wet, medium to rich sites.	High (moderate)
Betula papyrifera (paper birch)	Common in BWBS, SBS, IDF, and ICH. Less common in CWH, CDF, PP, and BG. Absent from ESSF, MH, AT.	Variable. Prefers well-drained soils and medium to rich sites.	Low
Calamagrostis canadensis (bluejoint)	Occurs in all zones.	Upland and wetland, very poor to very rich sites. Disturbed soil and peat.	Low to moderate
Calamagrotis rubescens (pinegrass)	Most dense and widespread in IDF. Also common in SBS and MS, and lower elevations of ICH and ESSF.	Dry to moist. Drought tolerant.	Moderate (high)

TABLE 3. (Continued)

Species	Biogeoclimatic zones	Habitat conditions	Shade tolerance
Cornus sericea (red-osier dogwood)	All zones except AT. Rare in MH.	Moist to wet sites. Often on alluvial sites. Flood tolerant.	Moderate
Corylus cornuta (beaked hazelnut)	Primarily in ICH and drier CWH subzones. Also occurs in IDF, southern SBS, and BWBS.	Prefers moist, well-drained, moderate to very rich soils. Best on alluvial sites.	Moderate
Epilobium angustifolium (fireweed)	All zones.	Extremely variable, follows disturbance. Tolerates wide nutrient range. Best on mesic to subhygric sites.	Low
Gaultheria shallon (salal)	CWH, CDF, along entire length of coast.	Variable. Tolerates wide range of moisture and nutrient conditions. Best on moist deep soils. Often on rocky or boggy sites.	Moderate
Lonicera involucrata (black twinberry)	All forested zones, except northern subzones of BWBS.	Moist woods. Prefers medium to very rich sites. Often in frost pockets.	Moderate
Menziesia ferruginea (false azalea)	All zones except PP, BG, IDF, BWBS, and SWB. Abundant in CWH, MH, ESSF.	Variable sites, best on mesic sites. Forested habitats, brushfields.	High
Polystichum munitum (sword fern)	Abundant in CDF and CWH; uncommon in MH and ICH.	Moist, medium to rich sites.	High
Populus balsamifera ssp. *balsamifera* (balsam poplar)	Abundant in BWBS, less common in SWB. Occurs sporadically in some eastern subzones of SBS, IDF, ICH.	Alluvial or moist upland sites, best on rich sites. Very flood tolerant.	Very low
Populus balsamifera ssp. *trichocarpa* (black cottonwood)	All zones except SWB and AT.	Often on alluvial sites. Also moist uplands. Best on rich sites. Flood tolerant.	Very low

TABLE 3. (Continued)

Species	Biogeoclimatic zones	Habitat conditions	Shade tolerance
Populus tremuloides (trembling aspen)	Very abundant in BWBS, SBS, and IDF.	Variable. Dry to moist sites. High frost resistance.	Low
Pteridium aquilinum (bracken)	Most abundant in ICH, IDF, CDF, and drier CWH subzones.	Wide variety of disturbed habitats. Tolerates nutrient-poor sites.	Moderate
Rhododendron albiflorum (white-flowered rhododendron)	Most abundant in MH and wetter ESSF subzones. Also occurs in AT, upper CWH and ICH.	Forested and open slopes.	Moderate
Ribes bracteosum (stink currant)	Most abundant in CWH, also occurs in CDF, MH and moist areas of some Interior zones.	Moist woods, riparian or alluvial habitats, rich sites.	Moderate to low
Ribes lacustre (black gooseberry)	All zones except PP and BG.	Alluvial habitats and moist woods.	Low to moderate
Rosa spp. (roses)	All zones except AT, MH, SWB.	Variable. Occurs on moist and dry sites.	Moderate
Rubus idaeus (red raspberry)	All zones except MH and AT. Rare in PP and BG. Only in eastern parts of CWH and CDF.	Disturbed, open sites. Prefers moist moderately rich sites.	Low
Rubus parviflorus (thimbleberry)	All forested zones except SWB. Most abundant in CWH and wet Interior subzones. Rare in dry areas of Interior.	Variable. Prefers moist, rich sites.	Moderate
Rubus spectabilis (salmonberry)	Very abundant in CWH and CDF, common in MH, rare in Interior wet belt.	Tolerates variable soils and nutrient levels but favours moderate to rich sites. Moist slopes, streambanks, lowland forest.	Moderate
Salix spp. (willows)	Throughout B.C.	Extremely variable. Often riparian.	Low to moderate

TABLE 3. (Concluded)

Species	Biogeoclimatic zones	Habitat conditions	Shade tolerance
Sambucus spp. (elderberries)	All zones except MH, SBS.	Usually on moist, rich habitats.	Low to moderate
Symphoricarpos albus (common snowberry)	Throughout B.C. to approx. 56°N latitude. Most abundant in IDF.	Extremely variable. Drought tolerant.	Low
Vaccinium membranaceum (black huckleberry)	Most abundant in ESSF, ICH, MH, and cool, moist SBS subzones.	Dry to moist, poor to rich, coniferous forests and openings.	Moderate (high)
Vaccinium ovalifolium (oval-leaved blueberry)	Most abundant in CWH and MH on coast, and moist southeastern ESSF subzones in Interior.	Acidic coniferous forests. Dry to very wet, very poor to very rich sites.	High
Valeriana sitchensis (Sitka valerian)	Abundant in ESSF and MH. Also occurs at upper elevations of ICH, SBS, and MS.	Prefers moist to wet rich sites.	Moderate
Viburnum edule (highbush-cranberry)	All zones except PP, BG, and AT. Most abundant in SBS and BWBS in central and northern Interior.	Moist medium to rich sites, often alluvial.	Moderate

TABLE 4. Description and competitive status of selected species

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Acer circinatum (vine maple)	Deciduous, multi-stemmed shrub or small tree up to 10 m high.	Rapid growth for first 5 years, followed by decreasing growth.	Serious competitor where abundant.	Roots deplete soil moisture. May be allelopathic.	Nutrient-rich litter.
Acer glabrum (Douglas maple)	Small tree or multi-stemmed shrub up to 10 m tall.	Moderately rapid juvenile growth.	Not a major competitor in most of B.C. Most significant in IDF and ICH zones, and dry sites in other zones.	As a component of mixed communities, it can reduce light. Competition from moisture in IDF zone and other dry sites. May compete for soil nutrients.	Nutrient-rich litter. May provide shade on harsh, south aspects.
Acer macrophyllum (bigleaf maple)	Tree or large multi-stemmed shrub, may exceed 25 m in height.	Rapid juvenile growth. Stump sprouts may grow 2–4 m in 1st year.	Major competitor on rich, coastal sites. Very broad crown.	Large leaves produce deep shade. Heavy leaf fall smothers conifer seedlings.	Nutrient-rich litter. Litter cycles rapidly.
Alnus incana ssp. *tenuifolia* (mountain alder)	Small tree or multi-stemmed shrub up to 15 m tall.	Moderately rapid juvenile growth.	Forms dense thickets on wet sites.	Growth of conifer seedlings inhibited by shading and root competition. Conifer establishment inhibited by dense litter.	Nitrogen fixation. Builds up site organic matter.
Alnus rubra (red alder)	Tree or tall shrub up to 25 m tall.	Rapid juvenile growth. Can be 10 m tall by age 5.	Major competitor throughout its range, esp. with Douglas-fir. Can cause significant mortality.	Reduces light and moisture. Can cause physical abrasion of branches and leaders.	Nitrogen fixation. Builds up soil organic matter. May reduce losses to laminated root rot.

TABLE 4. (Continued)

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Alnus viridis (Sitka or green alder)	Small tree or coarse shrub up to 12 m tall. Rarely develops into a tree.	Growth rates vary greatly depending on size and site. Sitka alder takes 3–4 years to reach 1 m. Green alder grows more slowly.	Moderate competitor. Only serious where an extensive canopy forms. Single plants not a problem.	Extensive canopies can shade out conifer seedlings. In high snowfall areas, snowpress can lead to physical damage of conifers.	Nitrogen fixation. Builds up site organic matter.
Athyrium filix-femina (lady fern)	Perennial fern with large deciduous fronds up to 2 m tall.	Fronds have determinate growth. Rapid frond development in spring and dieback in autumn.	Not a widespread major competitor. Dense stands on moist, rich sites create serious local competition.	Competes for light and space. Smothering and mechanical damage from shedding fronds can be serious.	Unknown.
Calamagrostis canadensis (bluejoint)	Rhizomatous perennial grass to 200 cm tall.	Forms dense sods. Rapid height growth during growing season, but dies back in fall.	Serious competitor in the BWBS. Minor localized competition on wet sites in other zones.	Primarily root competition. Can also shade and mechanically damage seedlings. Grass sods inhibit conifer regeneration.	Can control surface soil erosion. May restrict establishment of larger species with longer-lasting, more serious impacts.
Calamagrostis rubescens (pinegrass)	Rhizomatous perennial grass usually less than 50 cm tall in the vegetative state, up to 1 m tall when flowering.	Loose open turf under forest stands, forms dense root mats following disturbance.	Major competitor in IDF zone; also competes in most SBS and MS subzones. Competition most severe on droughty sites.	Primarily moisture competition.	Can control surface soil erosion. Increases soil organic matter. May prevent overstocking of lodgepole pine. Can exclude more competitive species.

TABLE 4. (Continued)

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Cornus sericea (red-osier dogwood)	Deciduous shrub with many stems and prostrate rooting branches, up to 5 m tall.	Rapid early growth. Suckers or sprouts can grow 1 m in first growing season.	Significant competitor on subhygric to hygric sites. Part of a major brush community. Forms dense thickets.	Light.	No information.
Corylus cornuta (beaked hazelnut)	Deciduous multi-stemmed thicket-forming shrub up to 4 m tall.	Sprouts exhibit rapid growth and increase in vigour over time. Clonal expansion is slow but increases with time. Seedling growth is slow.	Can be an aggressive localized competitor.	Primarily shading. Also may compete for moisture. Ties up nutrients.	Nutrient-rich litter.
Epilobium angustifolium (fireweed)	Rhizomatous perennial herb, up to 3 m tall.	Sprouts early in growing season and dies back in autumn. Rapid aerial shoot growth. Rapid lateral expansion of rhizome-like root system. Seeds-in.	Very abundant and aggressive invader.	Reduces light. Dead stems often increase snow press, damaging young seedlings.	Can reduce invasion by woody competitors. Stores nutrients.
Gaultheria shallon (salal)	Evergreen, rhizomatous shrub, up to 2.5 m tall.	Slow growing. Forms very dense thickets.	Serious competitor on mesic and drier coastal ecosystems.	Competes for moisture on dry sites. Ties up nutrients. Extensive root system leads to below-ground competition.	Salal roots may increase organic matter.

TABLE 4. (Continued)

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Lonicera involucrata (black twinberry)	Deciduous shrub up to 3 m tall.	Moderate to rapid juvenile growth. Clumps do not expand rapidly.	Moderate competitor. Component of vigorous brush communities.	Reduces light as part of a mixed shrub community.	No information.
Menziesia ferruginea (false azalea)	Deciduous shrub up to 3 m tall.	Relatively slow growing. Long life-span.	Little known. Part of ericaceous shrub complex that is major brush problem in ESSF zone in southern Interior.	May compete below-ground. May interfere by reducing light and soil temperature.	No information.
Polystichum munitum (sword fern)	Large perennial fern with evergreen fronds and a woody rhizome, up to 1.8 m tall.	Fronds have determinate growth and persist for several years.	Competes significantly in localized areas. Abundant on moist rich coastal sites. Occurs in pure uniform stands.	May compete for moisture and light. Can provide habitat for tree-damaging mammals.	No information.
Populus balsamifera ssp. *balsamifera* (balsam poplar)	Deciduous tree with long straight trunk and open crown, up to 35 m tall and 80 cm in diameter.	Rapid juvenile growth especially when of sucker origin. Can maintain rapid growth for first 40–50 years.	Can be serious competitor because of rapid growth, and prolific sucker, sprout, and seed production.	Reduces light. May compete for water and nutrients.	Nutrient-rich litter.
Populus balsamifera ssp. *trichocarpa* (black cottonwood)	Large deciduous tree with long straight trunk and open crown, up to 40 m tall and 150 cm in diameter.	Extremely rapid juvenile growth.	Serious competitor on alluvial sites. Competition continues for length of rotation.	No information.	Nutrient-rich litter.

TABLE 4. (Continued)

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Populus tremuloides (trembling aspen)	Medium-sized deciduous tree commonly 6–12 m tall but sometimes up to 25 m tall.	Rapid juvenile growth. Suckers can grow 2 m in the first growing season.	Major competitor throughout the interior, esp. SBS and BWBS zones. Produces prolific suckers.	Dense suckers compete severely for light. Aspen canopy commonly causes mechanical damage to understory conifers.	Nutrient-rich litter.
Pteridium aquilinum (bracken)	Tall rhizomatous perennial fern, up to 2 m tall.	Extensive underground growth. Fronds expand rapidly but die back in autumn.	Dominates a wide variety of sites. Forms a dense canopy. Severely inhibits associated plants.	Competes aboveground by shading, smothering, and mechanical damage. Roots and rhizomes compete for moisture and nutrients. May be allelopathic. Heavy litter may inhibit conifer root systems.	No information.
Rhododendron albiflorum (white-flowered rhododendron)	Deciduous, slender-branched shrub, up to 2.5 m tall.	Relatively slow growing. Long life span.	Major component of an ericaceous shrub complex.	Reduces light and soil temperature. May compete for soil nutrients; may compete for moisture on dry sites.	May provide shade on exposed droughty sites.
Ribes bracteosum (stink currant)	Erect to spreading deciduous shrub, up to 3 m tall.	Relatively rapid growth.	Abundant component of vigorous complexes on moist rich sites on the mid- and north coast.	Probably competes primarily for light.	No information.

TABLE 4. (Continued)

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Ribes lacustre (black gooseberry)	Straggly deciduous shrub, up to 1.5 m tall.	Slow growth.	Not a major competitor, but is a common member of brush complexes on moist and alluvial sites.	Light competition can be severe.	No information.
Rosa spp. (roses)	Deciduous perennial shrub, stems erect or trailing, up to 2.5 m tall.	Root systems develop rapidly. Maximum ht. is attained within 10 years. Can form dense thickets.	Member of brush complex that may be a major competitor to seedlings.	As a component of mixed shrub communities, it contributes to competition for light, moisture, and nutrients.	No information.
Rubus idaeus (red raspberry)	Deciduous, rhizomatous shrub with biennial canes up to 2 m tall.	Rapid above- and below-ground growth, but canes are short-lived (2 yr).	Aggressive, invading plant. Can form a dense canopy 3–5 years after disturbance.	Competes for light as a component of mixed shrub communities. Expect shading and mechanical damage to young seedlings.	Limits invasion of taller, longer-lived species.
Rubus parviflorus (thimbleberry)	Deciduous, rhizomatous shrub with short-lived (2–3 yr) canes, up to 2 m tall.	Rapid above- and below-ground growth.	Major competitor throughout B.C. Forms a very dense canopy and can quickly smother seedlings.	Appears to compete primarily for light. May compete for moisture in dry summers. Litter can smother conifer seedlings.	On some sites, light to moderate cover may reduce physiological stresses on conifer seedlings.

TABLE 4. (Continued)

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Rubus spectabilis (salmonberry)	Deciduous, rhizomatous, erect or creeping shrub, up to 5 m tall.	Rapid shoot and rhizome growth, but canes are relatively short-lived (probably 10-15 yr).	Major competitor on moist, rich coastal areas. Forms dense thickets.	Primarily competes for light. Causes conifer growth losses and mortality.	Can inhibit invasion of hardwood trees.
Salix spp. (willows)	Deciduous small tree and multi-stemmed shrubs. Variable in size.	Rapid early growth, especially when of sprout origin.	Moderate to serious competitor. Easily outgrows conifers.	No information.	No information.
Sambucus spp. (elderberries)	Deciduous coarse shrub or small tree with a broad, arching crown, up to 9 m tall.	Rapid sprout growth — easily outgrows conifers. Seedling growth relatively slow.	Rarely a primary competitor, but part of major brush complexes on productive sites.	Reduces light. Allelopathy possible.	May provide shade on harsh, droughty sites.
Symphoricarpos albus (common snowberry)	Small to medium-sized erect, deciduous shrub up to 2 m tall.	Relatively slow growth, except on very favourable sites.	Moderate competitor. Abundant on dry sites in southern Interior.	Reduces light. May compete for soil moisture on dry sites.	May provide shade on harsh, droughty sites.
Vaccinium membranaceum (black huckleberry)	Small to medium-sized deciduous, rhizomatous shrub up to 2 m tall.	Slow height growth and lateral spread.	Competes as a major component of an ericaceous shrub complex.	Contributes to competition for light in mixed communities. May compete significantly for moisture and nutrients on dry and nutrient-poor sites.	No information.

TABLE 4. (Concluded)

Species	Growth habit	Growth	Competitive status	Mode of competition	Benefits to conifers
Vaccinium ovalifolium (oval-leaved blueberry)	Diffusely branched deciduous shrub up to 2 m tall.	Slow-growing, usually less than 30 cm/yr.	Minor competitor, but abundant component of ericaceous shrub complex.	No information.	No information.
Valeriana sitchensis (Sitka valerian)	Erect, rhizomatous herbaceous perennial.	No information.	May be a serious competitor on some sites.	Reduces available light; reduces available below-ground growing space. Decaying stems cause mechanical damage.	Nutrient-rich litter.
Viburnum edule (highbush-cranberry)	Straggling to erect, multi-stemmed, deciduous shrub up to 3.5 m tall.	Probably relatively slow height growth and lateral spread.	Not a major competitor except in the north, but part of major brush complexes. Competes with white and black spruce.	Contributes to competition for light in mixed communities.	No information.

TABLE 5. Reproductive characteristics of selected species

Species	Sexual reproduction: Propagule description	Sexual reproduction: Dispersal mechanism	Sexual reproduction: Miscellaneous	Vegetative reproduction	Comments
Acer circinatum (vine maple)	Winged seeds.	Wind.	Low seed viability. Plants rarely establish from seed.	Layering. Rooting.	Layering most important form of regeneration.
Acer glabrum (Douglas maple)	Winged seeds.	Wind.		Basal sprouts.	
Acer macrophyllum (bigleaf maple)	Large winged seeds.	Wind. Infrequently small animals and birds.	Does not seed-in aggressively. Seed decays 1 year after dispersal. Seedling survival depends on adequate moisture.	Basal sprouts from stumps.	Seedling banker.
Alnus incana ssp. *tenuifolia* (mountain alder)	Small, winged nutlets.	Wind. Water.	Low seed viability. No treatment or chilling required for germination. Mineral soil seedbed preferred.	Basal sprouts. Layering.	May be clone-forming.
Alnus rubra (red alder)	Small, winged nutlets.	Wind.	Moist mineral seedbed preferred. Seed viable for 1 year in field.	Basal (stump) sprouts; sprouting vigour declines with age.	Aggressively seeds-in to disturbed sites.
Alnus viridis (Sitka or green alder)	Small, winged nutlets.	Wind. Water.	Moist mineral soil seedbed preferred.	Basal sprouts.	Seeds-in to disturbed sites.

TABLE 5. (Continued)

Species	Sexual reproduction			Vegetative reproduction	Comments
	Propagule description	Dispersal mechanism	Miscellaneous		
Athyrium filix-femina (lady fern)	Spores.	Wind, water, and animals.	Requires free water for sexual reproduction to succeed. Majority of spores landing on forest floor do not germinate.	Rhizomes.	Prolific, widely disseminated spores. Forms large non-clonal stands.
Betula papyrifera (paper birch)	Small, winged nutlets.	Wind. Water.	Dispersal mostly within 100 m of tree. Shaded moist mixed mineral/ organic seedbed preferred.	Basal (stump) sprouts. Sprouting vigour declines with age.	Seeding-in most important form of reproduction.
Calamagrostis canadensis (bluejoint)	Light seeds.	Wind.	Germinates on disturbed sites.	Rhizomes.	Rapidly seeds-in to disturbed sites, then spreads rhizomatously.
Calamagrostis rubescens (pinegrass)	Light seeds.	Wind.	Seed only produced in open areas.	Rhizomes.	Primarily a rhizomatous species, but seeds-in to disturbed areas.
Cornus sericea (red-osier dogwood)	Heavy globular fruit with a single seed.	Birds. Mammals.	Seed-banking species.	Stolons (esp. on moist or wet sites), runners, root suckers, basal sprouts, layering.	Buried branch parts often root. Buried seed may germinate after a disturbance.

TABLE 5. (Continued)

Species	Sexual reproduction: Propagule description	Sexual reproduction: Dispersal mechanism	Sexual reproduction: Miscellaneous	Vegetative reproduction	Comments
Corylus cornuta (beaked hazelnut)	Hard-shelled nuts.	Small mammals. Birds.	Infrequent crops. High losses to predators. Low germination rates; seeds must remain moist.	Suckers. Basal sprouts. Layering.	Forms extensive clones. Vegetative reproduction is dominant means of colonization.
Epilobium angustifolium (fireweed)	Small, tufted seeds.	Wind.	Copious seed production. Rhizome-like root system. Detached plant parts regenerate.	Aggressively seeds-in to disturbed sites, and spreads by rhizomes. Forms extensive colonies.	
Gaultheria shallon (salal)	Many-seeded fleshy capsules.	Birds. Mammals.	Best germination on decaying wood. Seedling survival is low.	Root suckers. Basal sprouts. Layering.	Once established, further expansion is almost entirely by vegetative means.
Lonicera involucrata (black twinberry)	Paired berries.	Birds. Mammals.	Seed-banking species.	Basal sprouts.	Apparently not an aggressive invader, but little is known.
Menziesia ferruginea (false azalea)	Small, naturally dehiscent seeds.	Gravity. Wind.	Germinates readily without cold treatment. High germination rate.	Basal sprouts. Layering.	Apparently not an aggressive invader, but little is known.
Polystichum munitum (sword fern)	Spores.	Gravity, wind, water, and animals.	Free water required for successful sexual reproduction.	Woody rhizome divides and becomes branched with age.	Prolific, widely disseminated spores.

TABLE 5. (Continued)

Species	Sexual reproduction: Propagule description	Sexual reproduction: Dispersal mechanism	Sexual reproduction: Miscellaneous	Vegetative reproduction	Comments
Populus balsamifera ssp. *balsamifera* (balsam poplar)	Fluffy seeds.	Wind. Water.	Prolific seed producer; good seed crops every year. Germination occurs readily on exposed mineral soil.	Root suckers. Basal (stump) sprouts. Buried branch parts often root.	Both seeding-in and suckering are important means of reproduction.
Populus balsamifera ssp. *trichocarpa* (black cottonwood)	Fluffy seeds.	Wind. Water.	Good seed crops every year. Moist seedbed essential for germination and seedling survival.	Basal (stump) sprouts. Buried branch parts often root.	Seeding-in is the dominant means of reproduction.
Populus tremuloides (trembling aspen)	Fluffy seeds.	Wind.	Seedling establishment is rare.	Root suckers. Basal (stump) sprouts (rare).	Rapidly colonizes areas through root suckering. Produces extensive clones.
Pteridium aquilinum (bracken)	Spores.	Gravity, wind, water, and animals.	Most often germinates on sterile, disturbed soil.	Rhizomes. Stem fragments readily regenerate.	Forms large clones through rhizomatous growth.
Rhododendron albiflorum (white-flowered rhododendron)	Small, naturally dehiscent winged seeds.	Wind.	Little known, but seedling establishment probably rare.	Basal sprouts. Layering.	Not an aggressive invader.
Ribes bracteosum (stink currant)	Glandular berries.	Birds. Mammals.	Seed-banking species.	Basal sprouts. (Layering.)	Seedling establishment on disturbed soil probably most important means of reproduction.

TABLE 5. (Continued)

Species	Sexual reproduction: Propagule description	Sexual reproduction: Dispersal mechanism	Sexual reproduction: Miscellaneous	Vegetative reproduction	Comments
Ribes lacustre (black gooseberry)	Glandular berries.	Gravity. Birds. Mammals.	Seed-banking species.	Layering.	Rhizomatous extension is limited.
Rosa spp. (roses)	Small bony seeds within hips.	Birds. Mammals.	Very difficult germination. Some species bank seed.	Root suckers. Basal sprouts. Layering.	
Rubus idaeus (red raspberry)	Aggregate berry-like fruit.	Birds. Animals.	Seed-banking species.	Rhizomes. Basal sprouts.	Rapidly establishes on disturbed sites from seed. Once established, further spread is by rhizomatous growth.
Rubus parviflorus (thimbleberry)	Aggregate berry-like fruit.	Primarily birds but also mammals.	Seed-banking species.	Strongly rhizomatous. Basal sprouts. Layering.	Rapidly establishes on disturbed sites from seed and rhizomes. Once established, further spread is by rhizomatous growth.
Rubus spectabilis (salmonberry)	Aggregate, berry-like fruit.	Birds. Mammals. Gravity.	Seed-banking species. Most seed is deposited directly below parent plant. Seedling establishment requires mineral soil.	Strongly rhizomatous. Basal sprouts. Layering.	Rapidly establishes on disturbed sites by seed. Once established, further spread is by rhizomatous growth.

TABLE 5. (Continued)

Species	Sexual reproduction: Propagule description	Sexual reproduction: Dispersal mechanism	Sexual reproduction: Miscellaneous	Vegetative reproduction	Comments
Salix spp. (willows)	Fluffy seeds.	Wind. Water.	Seeds of most species germinate in summer within a few days of dispersal.	Basal sprouts.	Sprout growth can be prolific, but seeding-in is the dominant means of reproduction.
Sambucus spp. (elderberries)	Berry-like fruit.	Birds. Mammals.	Seed-banking species. Germinates on mineral and organic seedbeds.	Basal sprouts. Layering. (Rhizomes.)	Clones persist through vegetative reproduction. May form clones in some areas. Can seed-in to disturbed sites.
Symphoricarpos albus (common snowberry)	Berry-like fruit.	Birds. Mammals.	Produces good seed crops almost every year. Seed-banking species.	Basal sprouts. Rhizomes.	Establishes by seed on disturbed soils. Once established, spreads by rhizomes to form low thicket.
Vaccinium membranaceum (black huckleberry)	Berries.	Birds. Mammals.	Berry production highly variable between years.	Rhizomes. Basal sprouts.	Once established, further spread is by rhizomatous growth.
Vaccinium ovalifolium (oval-leaved blueberry)	Berries.	Birds. Mammals.	Seed-banking species but stored seed is apparently unimportant for regeneration. Best seedling survival on humus.	Rhizomes. Basal sprouts.	

TABLE 5. (Concluded)

Species	Sexual reproduction			Vegetative reproduction	Comments
	Propagule description	Dispersal mechanism	Miscellaneous		
Valeriana sitchensis (Sitka valerian)	Small hard seed with feathery plume.	Wind.	Little information.	Rhizomes.	Short rhizomes suggest that vegetative spread is limited.
Viburnum edule (highbush-cranberry)	Berry-like fruit with a single seed.	Birds. Mammals. Gravity.	Seed-banking species. Germination is difficult.	Layering. Basal sprouts. (Rhizomes.)	Does not expand rapidly after establishment.

4 RESPONSE TO MANAGEMENT TREATMENTS

Section 6 of the guide summarizes information about how each plant species respond to current forest management treatments. The treatments are grouped into the following categories: 1) overstory removal, 2) manual treatments, 3) chemical treatments, 4) mechanical site preparation, 5) prescribed burning, and 6) other treatments. Explanatory notes pertaining to each of these treatment types appear below.

There are several important factors that must be taken into account in interpreting the information:

- The response of a particular plant will depend on the phase of the plant's life cycle during which the treatment is employed. Juvenile plants often respond differently from mature plants. Plants will respond differently to treatments applied during the dormant season, early in the growing season, or late in the growing season.
- Many plants regenerate from sprouts or suckers, as well as from seed. The resulting plants may differ radically in size, growth rates, and resistance to disturbance.
- Most species included in this guide occur over a wide geographic area and in a wide range of habitats in British Columbia. These plants may vary significantly in their genetic makeup. In addition, the response of a particular plant to a treatment will also vary according to local environmental conditions, and to the plant's competitive ability on a particular habitat.
- Individual plants are normally present as part of a vegetation complex, or plant community. Competition with associated plants may have a major influence on the response of an individual plant to a treatment. It is beyond the scope of this guide to consider the behaviour of vegetation complexes.
- The focus of this guide is on the response of selected herbs, shrubs and broad-leaved trees to management treatments. When a treatment is described as ineffective in reducing the frequency and cover of a plant species, this does not necessarily mean that establishment of coniferous trees will be unsuccessful. Conversely, a treatment that successfully reduces the frequency and cover of a plant species will not necessarily enhance the survival or growth of coniferous trees. For example, a mechanical site preparation treatment may increase the number of stems of a shrub; but the improved growing conditions and the delay in the recovery of the shrub may be sufficient to allow the coniferous seedling to reach a free-growing state.

4.1 Overstory Removal

Timber harvesting releases species from overstory shade. Some degree of physical disturbance to understory plants and to the forest floor also takes place. The removal of the tree canopy and associated soil disturbance may create conditions favourable for the germination of freshly deposited or stored seeds of these pioneer species.

Deciduous tree species present in the overstory at the time of harvesting may be cut or left standing. Comments about the response of mature deciduous trees to cutting are included in this section. For some of the plant species, the effect of conifer thinning is also discussed under this heading.

Table 6 includes a summary of the response of the plant species to overstory removal.

4.2 Manual Treatments

Manual treatments involve cutting or girdling plants. Girdling treatments are generally applied only to tree species. Most perennial species sprout from dormant buds on the stem base or root crown, or produce suckers from roots or rhizomes after the stems are cut. Several factors appear to influence the response of a species to cutting:

- The age of the plant. Sprout or sucker vigour generally decreases with age.
- Season of treatment. Most species sprout or sucker less vigorously if they are cut during the growing season, particularly if they are cut early in the season soon after shoot elongation and leaf development have ceased.
- Height and angle of the cut stump. Lower stumps usually produce fewer sprouts.
- Repeated cuttings. In some species, sprout or sucker vigour is diminished significantly following two or more cuttings. Repeated cuttings eventually deplete the carbohydrate reserves of susceptible plants.

Table 6 summarizes the response of the plant species to manual treatments.

4.3 Chemical Treatments

The response of a plant species to a herbicide can vary considerably depending on the season and method of application, the carrier, dosage, weather conditions, and other factors. Within a given species, susceptibility to a particular chemical may vary by latitude and other environmental factors.

These variables make it difficult to summarize the response of a species to chemical treatment. For this reason, terms such as "good control" or "variable results" have been used in the guide to generalize the information for each species or chemical. Where appropriate, factors such as season, application method, carrier, and dosage have been specified. The comments are not a prescription for herbicide application, but rather a guide to the expected response of the species to the treatment described.

The emphasis in this section is on chemicals currently registered for forestry use in British Columbia: glyphosate (Vision®), hexazinone (Velpar®), asulam (Asulox®), 2,4-D, simazine (Princep® or Aquazine®), and amitrol (Amitrol-T®). Two unregistered chemicals, triclopyr (Garlon®) and picloram (Tordon®), are also mentioned in a few cases.

Table 7 summarizes current information on the response of the plant species to chemical treatments.

4.4 Mechanical Site Preparation

There is little information documenting the response of a plant species to specific mechanical site preparation treatments. Most of the published information concerns the ability of the plant to invade areas of disturbed mineral soil or to regenerate from root or stem fragments.

The response of a plant to mechanical site preparation treatments varies significantly according to the severity of the treatments. Most plant species that colonize sites primarily by vegetative means can be eradicated by treatments that uproot and remove roots and rhizomes. Such intensive land clearing techniques are rarely used as part of current silvicultural practice.

Table 6 summarizes the response of the plant species to mechanical site preparation treatments.

4.5 Prescribed Burning

Plants differ greatly in their ability to withstand or recover from fire. Many of the major competing species are well adapted to, or even favoured by, fire. Other species can be controlled through a single prescribed burn. The response of a plant species to fire depends on: 1) the resistance of its above-ground parts to fire damage; 2) the ability of a species to reproduce vegetatively from underground rhizomes or roots; 3) the depth of a plant's roots or rhizomes; 4) the ability of a species to reproduce from seed stored in surface soil horizons; and 5) a species' efficiency in dispersing fresh seed onto newly burned seedbeds.

The intensity and duration of a fire have a significant impact on a plant's ability to survive and re-establish. Burns carried out when humus

and surface soil layers are dry, or over coarse textured soils, may allow heat to penetrate deeply into the soil, destroying buried seed and killing underground organs. A light fire that does not remove humus layers, but simply warms the mineral soil, may stimulate the germination of buried seed, or stimulate sprouting and suckering from dormant buds in undamaged portions of the plant.

Some fire-adapted species are favoured by severe fires and can withstand frequent, repeated fire, but the recovery of most species is inversely related to the severity of the fire.

Table 6 summarizes the response of the plant species to prescribed burning.

4.6 Other Treatments

There are many other potential forest management treatments in addition to those outlined above, but few have been documented with respect to their effects on specific plant species. Under this heading in the species summaries, we discuss the effects of fertilization, grazing, and grass seeding on a limited number of plant species.

Combinations of manual, chemical, mechanical, and burning treatments are also discussed. Because they may take advantage of plants' vulnerability during a recovery phase, combination treatments can be some of the most effective treatments for controlling vegetation.

TABLE 6. Summary of species response to forest management treatments

Species	Overstory removal	Manual treatments	Mechanical site preparation	Burning
Acer circinatum (vine maple)	Increases. Stem fragments and roots (?) sprout. Rarely seeds-in.	Prolific sprouter following cutting. Can recover in 2–3 years.	Roots and coppices. Eliminated by deep disturbance. Rarely seeds-in.	Sprouts vigorously. Severe fires can kill plant.
Acer glabrum (Douglas maple)	Static or slow increase.	Moderate or vigorous sprouter following cutting.	Damaged stems sprout. Seeding-in may occur on disturbed areas.	Moderate to severe fires can kill plant. Light fires promote sprouting and can increase cover.
Alnus macrophyllum (bigleaf maple)	Static or increases.	Sprouts vigorously from cut stump.	Damaged stems sprout. Seedling establishment rare.	Severe burns can kill plants. Usually sprouts back vigorously.
Alnus incana ssp. *tenuifolia* (mountain alder)	Increases on wet sites.	Sprouts.	Seeds-in to exposed mineral soil.	Set back by moderate to severe fires.
Alnus rubra (red alder)	Rapid increase. Invades by seed.	Moderate sprouter. To minimize sprouts, girdle or cut in late summer, low flat stump. Sprouting vigour declines with age.	Invades exposed mineral soil. Expect increase after treatment.	Burns can reduce stump sprouting. Seedlings establish on exposed soil.
Alnus viridis (Sitka or green alder)	Static or slow increase.	Sprouts with moderate or low vigour.	Slow invader of exposed mineral soil. Damaged stems sprout.	Moderate burns can control this species.

TABLE 6. (Continued)

Species	Overstory removal	Manual treatments	Mechanical site preparation	Burning
Athyrium filix-femina (lady fern)	Increases on wet sites. Decreases on drier sites.	No information.	Can provide good control.	Burns decrease cover and frequency on dry sites. Light burns can increase the species on wetter sites.
Betula papyrifera (paper birch)	Increases. Rapidly invades exposed mineral soil by seeding-in.	Moderate to vigorous sprouter. To minimize sprouts, girdle, or cut during growing season.	Stimulates seeding-in, especially on mixed organic and mineral seedbeds. Expect more seeding-in than after burning or no site preparation. Damaged stems sprout.	Burns stimulate seeding-in. Seed mainly establishes on exposed mineral soil and not on burned LFH.
Calamagrostis canadensis (bluejoint)	Rapidly increases. Invades by seed and rhizomatous growth.	Cutting is not an operational treatment. The species does not tolerate heavy cutting.	Quickly invades, even after heavy disturbance.	Cover and frequency can rapidly increase by rhizomatous sprouting and seeding-in. Expect greatest increases on wet to moist sites.
Calamagrostis rubescens (pinegrass)	Increases. Invades by rhizomes and seeding-in.	Grazing and clipping can control the species.	Increases rapidly following light or medium disturbance. Severe disturbance provides longer control but also leads to increased abundance.	Increases in cover and frequency. Sprouts and seeds-in vigorously.

TABLE 6. (Continued)

Species	Overstory removal	Manual treatments	Mechanical site preparation	Burning
Cornus sericea (red-osier dogwood)	Static or slow increase.	Sprouts and suckers. Vigour can be reduced by multiple cuttings.	Damaged stems sprout and sucker. Cover unlikely to change significantly.	Set back by severe fires. Light burns stimulate sprouting but may not result in rapid increases in abundance or cover.
Corylus cornuta (beaked hazelnut)	Static or slow increase.	Sprouts and suckers vigorously. Vigour unaffected by repeated cuttings.	Resprouting will occur unless underground stems are destroyed. Deep scarrification or discing can reduce sprouts and suckers.	Aerial parts are easily killed by fire. Expect vigorous regrowth leading to an increase in stem density.
Epilobium angustifolium (fireweed)	Rapid increase. Invades by seeding-in then rapidly spreads by suckering.	Sprouts and suckers.	Rapidly invades disturbed areas. Damaged parts sprout or sucker.	Establishment and expansion of colonies is highly favoured on burned sites.
Gaultheria shallon (salal)	Slow but steady increase of aboveground parts. Below-ground plant parts may rapidly increase.	Sprouts and suckers. Regrowth is often slow but stem density increases.	Varied response. Sets back growth but usually increases stem density.	Expect severe burns on dry sites to reduce sprouting. Light burns on wetter sites tend to increase cover. After most burns, aboveground plant parts recover slowly but below-ground parts increase quickly.
Lonicera involucrata (black twinberry)	Static or slow increase. Expect an increase on moist, rich sites.	Sprout.	No information.	Severe burns set back or eliminate the species. Light burns stimulate vigorous sprouting.

TABLE 6. (Continued)

Species	Overstory removal	Manual treatments	Mechanical site preparation	Burning
Menziesia ferruginea (false azalea)	Static following winter logging. Slow recovery following logging that damages the plant.	Sprouts with low to moderate vigour.	Reduces abundance. Slow to recover.	Fire sensitive. Significantly reduced in abundance; slow to recover.
Polystichum munitum (sword fern)	Static or increases on wet sites. Static or decreases on dry sites.	No information.	Techniques that uproot plant will reduce abundance.	Variable results depending on fire severity and soil moisture.
Populus balsamifera ssp. *balsamifera* (balsam poplar)	Increases (can be dramatic) by suckering and possibly seeding-in.	Sprouts and suckers vigorously. Cutting during growing season minimizes regrowth.	Promotes suckering. Provides a seedbed.	Burns stimulate suckering. Severe burns may retard sprouting.
Populus balsamifera ssp. *trichocarpa* (black cottonwood)	Increases. Invades by seed.	Sprouts vigorously. Cutting during growing season minimizes regrowth. Repeated cutting does not reduce sprout vigour.	Provides a suitable seedbed for the large annual seed crops. Stem and root fragments readily regenerate.	Sprouting is stimulated. Severe burns may reduce sprouting vigour.
Populus tremuloides (trembling aspen)	Increases. Suckers vigorously.	Suckers vigorously. Girdle or cut during growing season to minimize suckering.	Promotes suckering. Intense deep scarification can reduce suckering. Negligible seeding-in occurs.	Promotes suckering. Density can be dramatically increased. Light burns minimize suckering.
Pteridium aquilinum (bracken)	Increases. Spreads rapidly by underground rhizomes.	Sprouts and suckers vigorously. Frond density increases.	Expect rapid regrowth. Repeated plowing is the only effective means of MSP.	Invades burned areas. Sprouts and suckers vigorously. Density increases.

TABLE 6. (Continued)

Species	Overstory removal	Manual treatments	Mechanical site preparation	Burning
Rhododendron albiflorum (white-flowered rhododendron)	Static following winter logging. Slow recovery following logging that damages the shrub.	Sprouts with low (or moderate?) vigour.	Reduces abundance. Slow to recover.	Susceptible to fires of moderate severity. Slow to recover.
Ribes bracteosum (stink currant)	Static or slow increase.	Sprouts vigorously. Rapid regrowth.	May promote seedling germination. Expect damaged stems to sprout.	Sprouts. Can take 2–3 years to recover.
Ribes lacustre (black gooseberry)	Increases usually but does not become abundant.	Expect sprouting following cutting.	May increase slightly.	Increases usually but does not become abundant. Light fires promote sprouting and seed germination. Severe fires can reduce cover.
Rosa spp. (roses)	Static or slow increase.	Sprouts with moderate vigour following cutting.	Sprouts with moderate vigour.	Persists or increases slightly after low to moderate burns. The species is eliminated or decreased by severe burns.
Rubus idaeus (red raspberry)	Rapid increase, especially on heavily disturbed areas.	Sprouts and suckers. Density increases.	Germinates on exposed mineral soil. Damage causes sprouting and suckering.	Invades burned areas using buried and new seed. Sprouts after light to moderate burns.
Rubus parviflorus (thimbleberry)	Rapid increase. Invades by stored or animal-carried seed.	Sprouts and suckers even after multiple cuttings. Density increases.	Invades exposed mineral soil. Damage causes sprouting and suckering.	Sprouts and suckers. Increases rapidly after light fires. Can recover slowly after severe burns.

TABLE 6. (Continued)

Species	Overstory removal	Manual treatments	Mechanical site preparation	Burning
Rubus spectabilis (salmonberry)	Rapid increase. Invades by stored or animal-carried seed.	Sprouts and suckers even after multiple cuttings. Density increases.	Invades exposed mineral soil. Broken stem parts may root.	Sprouts and suckers. Can rapidly increase following light or moderate fires. Cover may be reduced on dry sites.
Salix spp. (willows)	Increases.	Sprouts vigorously. Recovers rapidly. Density increases. Girdling causes severe basal sprouting.	Invades exposed mineral soil. Broken stem parts may root.	Sprouts. Quick, hot fires maximize sprouting; slower, longer burns reduce sprouting. Burns seldom eradicate the species.
Sambucus spp. (elderberries)	Static or slow increase. Individual plants may become very vigorous.	Sprouts vigorously. Very rapid growth.	Little information. Uprooted plants die. Damaged stems and rhizomes sprout vigorously. Germination of stored and imported seed is increased by exposure of mineral soil.	Sprouts. Seeding-in may occur. Fire can stimulate germination of stored seed.
Symphoricarpos albus (common snowberry)	Increases. Stimulates suckering and germination of buried and fresh seed.	Suckers and sprouts.	Exposing mineral soil improves germination of stored seed.	Suckers and sprouts. Severe fires reduce suckering. Light, quick fires can stimulate germination of buried seed.

TABLE 6. (Concluded)

Species	Overstory removal	Manual treatments	Mechanical site preparation	Burning
Vaccinium membranaceum (black huckleberry)	Static or slow increase. Plant vigour increases.	Sprouts and suckers. Slow to recover.	Decreases in abundance. Slow recovery. Seeds rarely establish on exposed mineral soil.	Sprouts and suckers following light or moderate burns. Expect mortality or slow recovery following intense burns. Seeding-in is rare.
Vaccinium ovalifolium (oval-leaved blueberry)	Static or slow increase. Plant vigour increases.	Sprouts with low vigour. May sucker.	Does not invade exposed mineral soil. Abundance probably reduced.	Abundance reduced. Slow recovery.
Valeriana sitchensis (Sitka valerian)	Plant vigour increases.	Vigorous plants recover quickly; shade-grown plants recover slowly.	No information.	Expect rapid recovery from light or moderate burns.
Viburnum edule (highbush-cranberry)	Static.	Sprouts with low or moderate vigour.	May stimulate germination of buried seeds; exposed mineral soil favours seeding-in. Expect damaged plants to sprout.	Sprouts. Expect quick, light fires to favour germination of buried seed.

TABLE 7. Effectiveness of registered herbicides[a]

Species	Chemical				
	2,4-D	Glyphosate	Hexazinone	Simazine	Asulam
Acer circinatum (vine maple)	4?	4	1	–	–
Acer glabrum (Douglas maple)	4	4–5	1–3	–	–
Acer macrophyllum (bigleaf maple)	1–2	3–4	–	–	–
Alnus incana ssp. *tenuifolia* (mountain alder)	4	4	1–2	–	–
Alnus rubra (red alder)	5	3–5	3	–	–
Alnus viridis (Sitka or green alder)	4	4	3	–	–
Athyrium filix–femina (lady fern)	1	4–5	–	–	–
Betula papyrifera (paper birch)	4	4	4	–	–
Calamagrostis canadensis (bluejoint)	1	4–5	4–5	4?	–
Calamagrostis rubescens (pinegrass)	–	4	4	4	–
Cornus sericea (red–osier dogwood)	1–2	3	2	–	–
Corylus cornuta (beaked hazelnut)	2–4	4	1	–	–
Epilobium angustifolium (fireweed)	2–4	4	3	2	–
Gaultheria shallon (salal)	1	1	1–(4)	–	–
Lonicera involucrata (black twinberry)	–	4–5	1–5	–	–
Menziesia ferruginea (false azalea)	2	4	–	–	–
Polystichum munitum (sword fern)	1–2	3–5	2	–	1–2
Populus balsamifera ssp. *balsamifera* (balsam poplar)	1–2	4–5	4	–	–
Populus balsamifera ssp. *trichocarpa* (black cottonwood)	1–2	4	2–5	–	–

TABLE 7. (Concluded)[a]

Species	Chemical				
	2,4–D	Glyphosate	Hexazinone	Simazine	Asulam
Populus tremuloides (trembling aspen)	3–4	4–5	4	–	–
Pteridium aquilinum (bracken)	1–2	4–5	–	–	4–5
Rhododendron albiflorum (white–flowered rhododendron)	–	3–4	–	–	–
Ribes bracteosum (stink currant)	2	2(4)	–	–	–
Ribes lacustre (black gooseberry)	2	2–4	2–4	–	–
Rosa spp. (roses)	3	2–4	4–5	–	–
Rubus idaeus (red raspberry)	2	3–4	3(4)	–	–
Rubus parviflorus (thimbleberry)	1–2	4	1–2	–	–
Rubus spectabilis (salmonberry)	1–2	5	1–2?	–	–
Salix spp. (willows)	4	3–5	2–5	–	–
Sambucus racemosa (red elderberry)	1–4	2–4	–	–	–
Symphoricarpos albus (common snowberry)	4	4–5	–	–	–
Vaccinium membranaceum (black huckleberry)	2–5	1–3	2?	1–2	–
Vaccinium ovalifolium (oval–leaved blueberry)	2	2?	–	–	–
Valeriana sitchensis (Sitka valerian)	–	–	–	–	–
Viburnum edule (highbush-cranberry)	–	2–4	1(2)	–	–

[a] Explanation of symbols:

1 Poor to no control
2 Moderate control
3 Variable control
4 Good control
5 Excellent control
– No information

5 WILDLIFE AND RANGE VALUES

Section 6 also includes information on the wildlife and range values of each plant species for food and other resources. Wildife information includes: the species' importance for wildlife; the principal wildlife species that use it; and the seasons of use. Range values are provided where available.

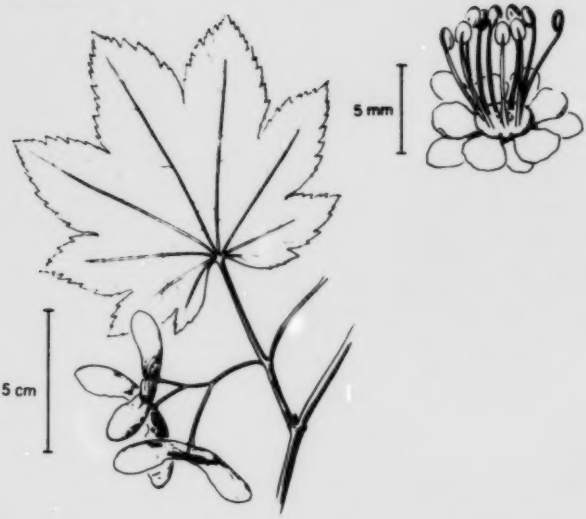
Information relating to wildlife use of plant species is highly variable within British Columbia. Heavy use of a plant species may reflect its abundance and availability, rather than its preferability over other plant species. Information provided under this heading should therefore be supplemented with knowledge from local wildlife experts.

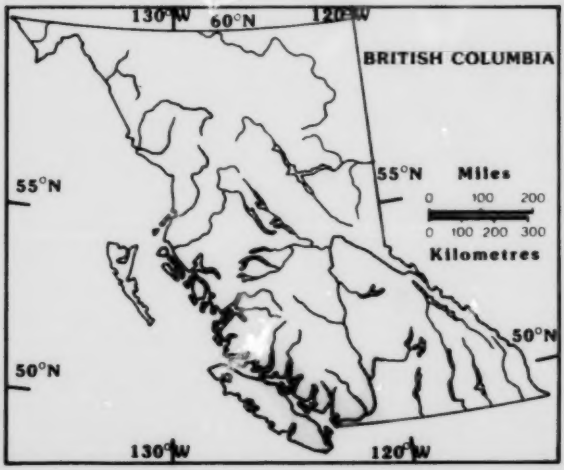
This part describes wildlife use of individual plant species, although wildlife often uses plant communities, rather than individual plant species. The early stages of succession provide valuable browse, forage, and cover for a wide variety of animal species. The extent and distribution of silviculture treatments in relation to the surrounding matrix of forest ecosystems can have a serious impact on the diversity of habitat and the balance of life requisites for large numbers of wildlife species.

All shrub species described have the potential to provide security or thermal cover to wildlife. Cover is not necessarily plant-specific; more important is the maintenance of acceptable forage/cover ratios during the planning and implementation of vegetation management prescriptions. Deciduous tree species described in this report may also be very important nesting sites for birds.

6 SPECIES SUMMARIES

Acer circinatum
(vine maple)





Distribution of *A. circinatum* in British Columbia.

Overstory Removal
- Expect an initial short-term decline followed by a substantial increase in height and cover.
- Root systems usually survive logging disturbance and are reported to resprout quickly after clearcutting. Plants also originate from stems buried during harvesting.

Manual Treatments
- Manual cutting is not effective in controlling vine maple.
- Prolific basal sprouting occurs after manual cutting or physical damage resulting from logging, crushing, or slashing.
- Sprouts can grow 90 cm in their first year.
- Crown volume and height can recover to pre-cut levels after 2–3 years.

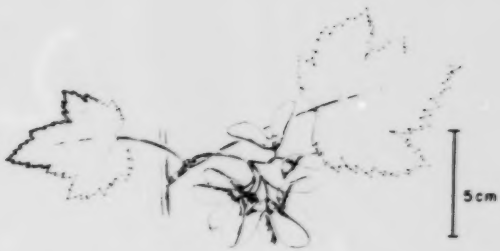
Chemical Treatments
- Glyphosate applied in late summer to mid-fall has effectively controlled vine maple. Mortality can occur at an application rate of 2 kg a.i./ha. Injured plants have continued to decline in vigour 2 years after application.
- Hexazinone applied as a broadcast spray is ineffective in controlling vine maple.
- 2,4-D amine applied to cut surfaces has controlled vine maple in Oregon.

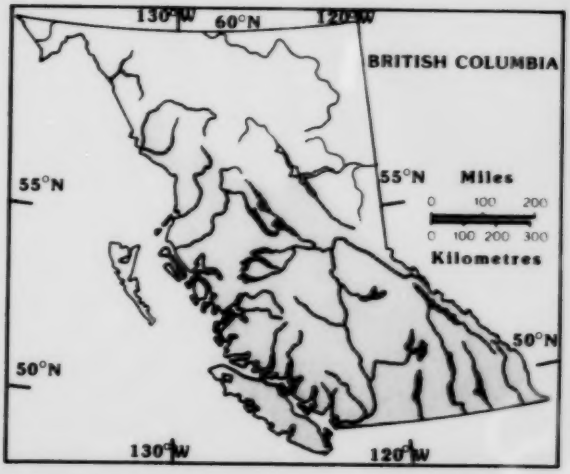
Mechanical Site Preparation
- Rooting and coppicing will occur if disturbance is not severe.
- Deep soil disturbance can eliminate vine maple.
- Vine maple rarely seeds-in, even on exposed mineral soil.

Prescribed Burning
- The basal portion of the stem and root system survives all but the most severe burns and can sprout vigorously.
- Vine maple often takes more than 10 years to regain its pre-disturbance cover.

Wildlife Values
- Vine maple is a very important winter forage species and common summer and fall forage for black-tailed deer.
- Vine maple communities provide habitat for Columbia black-tailed deer and rabbits.
- Shoots have moderate importance as winter and spring forage for Roosevelt elk.
- In Oregon, vine maple is preferred forage for mountain beaver.
- Browsing stimulates vigorous sprouting of vine maple.

Acer glabrum
(Douglas maple)





Distribution of *A. glabrum* in British Columbia.

Overstory Removal
- Abundance usually remains static or increases slightly following logging operations. Numbers of stems may sometimes increase rapidly.

Manual Treatments
- Rapid sprouting usually follows cutting.
- Cut stems have averaged 10 sprouts per stem within 3 years of cutting.
- Height growth of sprouts averages 0.5–1.5 m/yr and can reach 2.5 m/yr on productive sites in the ICH zone.

Chemical Treatments
- Glyphosate applied in the fall at 1.7 kg a.i./ha has provided good control in Oregon. Similar application rates have provided good control in wet ICH subzones in B.C. In the U.S. Inland Northwest, glyphosate has caused maximum top-kill at rates of 2.1 kg a.i./ha.
- Hexazinone has provided 60% control with 3.0 and 4.6 kg a.i./ha near Smithers.
- Foliar sprays of 2,4-D cause defoliation or top-kill; expect sprouting to follow. In the U.S. Inland Northwest, 2,4-D ester has often resulted in less than 35% top-kill.

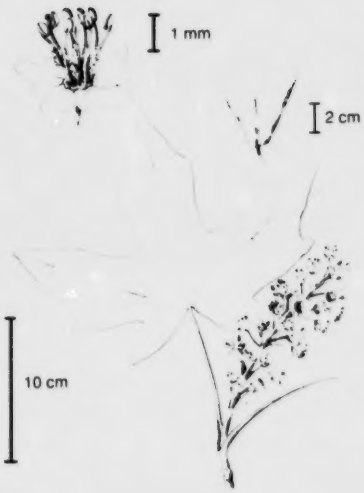
Mechanical Site Preparation
- Damaged stems often resprout.
- Douglas maple seeds-in to areas of disturbed soil.

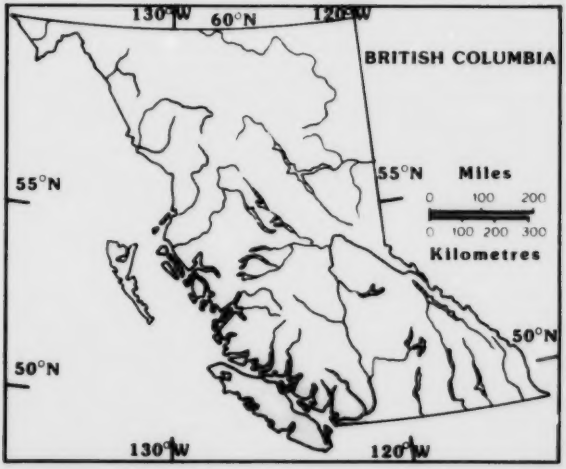
Prescribed Burning
- Response of Douglas maple to burning depends on fire severity.
- Plants sprout rapidly following light to moderate fires, resulting in an increase in the total number of stems present. After severe fires, survival can be low.
- Cover can increase dramatically over pre-burn levels within 5 years of burning.

Other Treatments
- Winter cutting followed by low-severity burning has resulted in minimal sprouting.

Wildlife Values
- Douglas maple is a preferred browse species for ungulates.
- The shrub is important as winter forage for deer and is moderately important as winter and spring browse for elk, moose, and bighorn sheep.

Acer macrophyllum
(bigleaf maple)





Distribution of *A. macrophyllum* in British Columbia.

Overstory Removal

- The number of individual clumps does not generally increase following logging.
- Established plants may increase in size and vigour.
- Seedling establishment is rare and is generally restricted to moist, rich sites.
- Trees damaged during logging sprout vigorously.

Manual Treatments

- Manual treatments alone will not reduce the cover of bigleaf maple. There is substantially less crown volume regrowth if glyphosate is applied to the cut surfaces immediately after cutting.
- Bigleaf maple sprouts rapidly after cutting and can grow 2–4 m in height in the first year.
- Cutting in late summer should produce the least number of sprouts.

Chemical Treatments

- To control bigleaf maple, the chemical must kill the root system, otherwise vigorous sprouting will occur.
- Effective control is achieved with injections (hack-and-squirt) or stump treatments.
- Injections or stump treatments before or during logging will minimize the number of stems requiring treatment.
- Stem treatments are most effective when performed during periods of slow growth or in the dormant season.
- Hack-and squirt treatments using glyphosate in the fall have provided effective control.
- Basal stem treatments with Garlon® have been very effective.
- Basal spray with 2,4-D ester in diesel oil provides moderate control for 2 years.
- Application of undiluted 2,4-D amine to cut surfaces in summer or late summer causes moderate injury in Washington and Oregon.
- Foliar sprays with glyphosate are effective, provided the foliage of coppices is completely covered with spray. Early fall applications may provide the best results.
- Aerial applications of 2,4-D in winter, spring, or summer have been ineffective in Washington, Oregon, and B.C.

Mechanical Site Preparation

- Damaged stems sprout rapidly.
- Bigleaf maple does not usually seed-in to areas of exposed mineral soil.
- Uprooting stumps results in good control.

BIGLEAF MAPLE

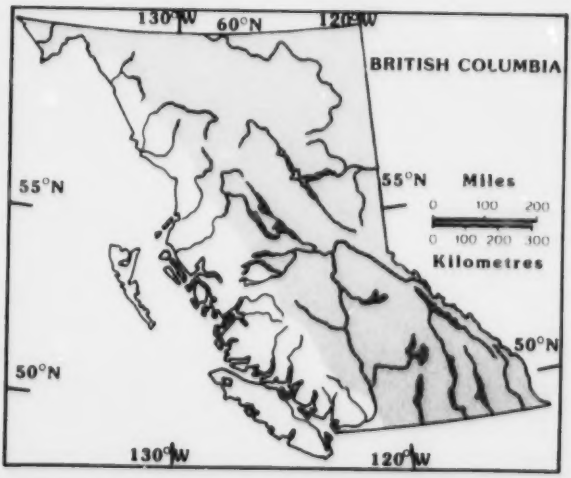
Prescribed Burning

- Top-kill usually occurs after fire. Vigorous sprouting from the bases of damaged stems will follow.
- Severe burns will kill some individuals.

Wildlife Values

- Young shoots are browsed by elk.
- Seedlings and saplings are a favoured food of black-tailed deer.
- Seeds are eaten by many small mammals and some birds.
- Rodents have been known to clip bigleaf maple seedlings and pull seedlings into burrows.
- Hollow maples are preferred den sites for raccoons.
- Bigleaf maple is an important nesting tree for hairy woodpeckers and is used by bald eagles for daytime perching in winter.

Alnus incana* ssp. *tenuifolia
(mountain alder)



Distribution of *A. incana* ssp. *tenuifolia* in British Columbia.

Alnus incana (L.) Moench ssp. _tenuifolia_ (Nutt.) Breit. **MOUNTAIN ALDER**

Overstory Removal
- Mountain alder will often increase significantly following overstory removal on very wet sites.

Manual Treatments
- Sprouts are produced from cut stem bases.
- In a closely related eastern alder, cutting in July or August produced the fewest and least vigorous sprouts. Cutting at 4–5 year intervals did not reduce sprout vigour.

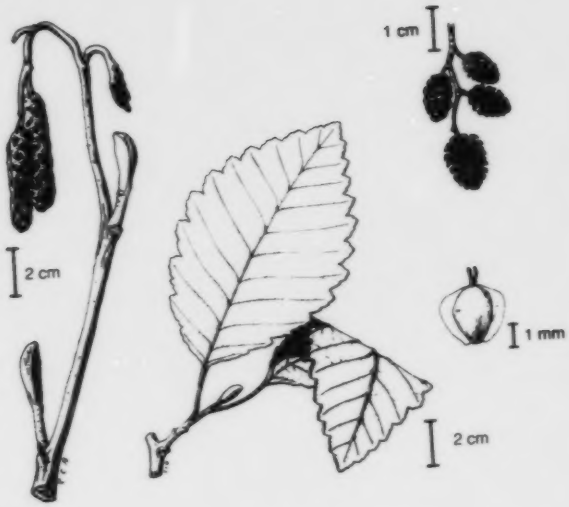
Chemical Treatments
- Both glyphosate and 2,4-D should successfully control mountain alder. Glyphosate is probably more effective. A broadcast application of glyphosate at 1.8 kg a.i./ha in early August in the SBSdw subzone severely damaged mountain alder.
- Hexazinone has little effect on mountain alder.

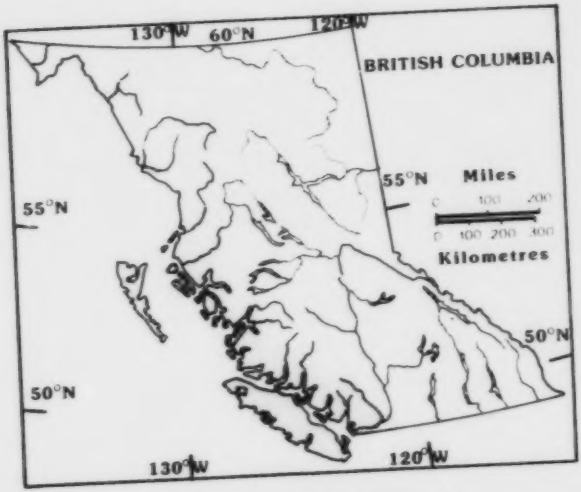
Mechanical Site Preparation
- Soil disturbance can create a suitable seedbed for germination and survival of mountain alder seedlings.
- Treatments that uproot the species will probably reduce its frequency.

Prescribed Burning
- Moderate to severe fires are needed to set back the growth of this species. Such fires will rarely be possible on the wet sites where mountain alder is abundant.

Wildlife Values
- Small and large mammals forage on the twigs and foliage.
- Snowshoe hares heavily browse mountain alder in Alaska.
- Seeds, buds, and catkins are eaten by many birds.
- Birds nest in mountain alder.

Alnus rubra
(red alder)





Distribution of *A. rubra* in British Columbia.

Overstory Removal

- Red alder rapidly seeds-in to disturbed, open areas following logging.
- Red alder seedlings can grow up to 1 m in height in their first season.
- Between the ages of 2 and 5 years, red alder seedlings can grow up to 3 m/yr.
- Red alder regeneration can be reduced by the removal of seed trees at least 1 year before harvest.

Manual Treatments

- Red alder will sprout from the stem following cutting, but it is not considered a strong sprouter compared with other species.
- Two to five sprouts per cut stem are normally produced.
- Studies in Washington state have shown that:
  1. Sprouting vigour is greatest on 1- to 4-year-old trees.
  2. Trees over 15 years rarely have living sprouts 2 years after cutting.
  3. Trees cut during the growing season have a significantly higher mortality rate than those cut in the dormant season. Trees cut in January have the lowest mortality.
  4. The lower the stump is cut, the higher the mortality rate. Mortality was 100% two growing seasons after 2-year-old alders were cut to 10 cm high stumps in July.
  5. Stumps with the cut surface facing north or east have the most mortality and are least likely to sprout. Mortality may be higher on stumps with a level cut than on stumps with an angled cut.
  6. Repeated cuttings will significantly reduce the vigour of sprouting.
- In B.C., the number of alder sprouts following cutting decreased as cutting was carried out from early to late in the growing season.
- Where salmonberry shaded alder stumps, virtually no alder sprouts survived.
- Girdling results in satisfactory top-kill and minimizes sprouting. Alder has been effectively girdled in every season. Double-frilled girdles are more effective than single girdles. Trees that are less than 15 years old or smaller than 15 cm dbh may resprout. Girdled trees can take over a year to die. To ensure seed tree control, girdling should be done 2–3 years before harvest.

Chemical Treatments

- Glyphosate applied as a foliar spray has caused moderate to very severe injury. The variation is largely determined by the age and size of the alder.
- Late summer foliar applications of glyphosate have been more effective than June or July applications.

- Glyphosate applied to cut surfaces between spring and fall is severely damaging to red alder.
- Cut stump treatment with 2,4-D amine in the fall has controlled red alder sprouts.
- Hack-and-squirt treatment with glyphosate or 2,4-D amine results in high rates of mortality.
- Thin-line treatments (application of concentrated herbicide directly to the bark of the lower part of the stem) of small red alder stems using 2.4–4.6 mL per stem of 2,4-D ester in diesel is very effective. May and June applications may be more effective than earlier applications.
- Thin-line and basal treatments with Garlon* are also effective.
- Hexazinone has been proven ineffective on scarified sites lacking a thick organic horizon.

Mechanical Site Preparation

- Mechanical treatments alone are not recommended for reducing red alder frequency or cover.
- Red alder will rapidly seed-in to areas of exposed mineral soil.
- Bare, loose, uncompacted mineral soil without dead shade is too harsh an environment for red alder seedlings to establish in the Oregon Coast Range and in the CDF zone in B.C.

Prescribed Burning

- Red alder's nitrogen-fixing capabilities allow it to establish and grow quickly on sites where burning has created a nitrogen deficiency.
- Seeding-in to mineral soil is the primary means of invasion following fire.
- Burns that do not expose mineral soil limit germination of red alder.
- Prescribed burning the first year following logging should greatly reduce alder arising from buried seeds.
- Burned alder stumps usually sprout less than unburned stumps, but results depend on the severity of the fire.

Other Treatments

- Seeding large areas of exposed mineral soil with grass mixtures may reduce invasion of red alder.

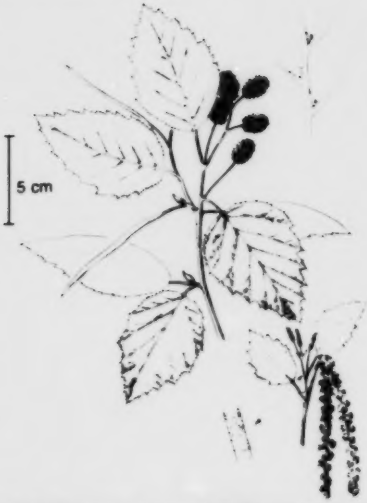
Wildlife Values

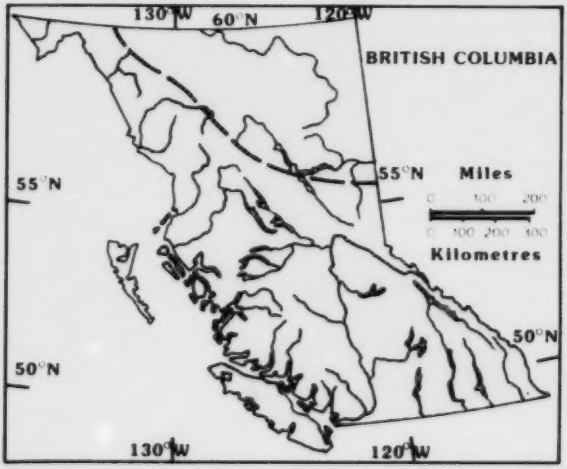
- Red alder is a moderately important summer and fall browse for black-tailed deer.
- Foliage, buds, and twigs are eaten by deer and elk.
- Many small mammals and some birds forage on red alder.
- There are several non-food resources of red alder:
  1. Riparian alder provides detritus which forms the basis of the food chain in many small streams. Riparian alder also maintains

stability of streambanks and moderates stream temperatures, thereby maintaining the quality of fish habitats.

2. Red alder stands may provide important alternative habitats for ungulates.
3. Beavers build their dams with red alder.
4. Red alder is important for cavity nesters such as woodpeckers, and for the daytime perching of bald eagles.

Alnus viridis* ssp. *sinuata
(Sitka alder)





Distribution of *A. viridis* in British Columbia. Subspecies *fruticosa* (green alder) is dominant north and east of the dashed line, while ssp. *sinuata* (Sitka alder) dominates to the south and west. There is a broad area of introgression between the two subspecies.

Overstory Removal

- Sitka alder cover increases following overstory removal.
- Competing vegetation hinders invasion of Sitka alder after logging.

Manual Treatments

- Cutting treatments are successful in temporarily setting back Sitka alder.
- Nearly all cut Sitka alder stems resprout after cutting.
- Sprout growth is moderate. One season after cutting, sprout height growth ranged from 20–120 cm/yr for sites throughout the Penticton District, and 30–60 cm/yr for an ICHmw site in the Boundary District. Sprouts grew 125 cm in height two growing seasons after late July cutting in the MSxk subzone.
- Sprout growth can be substantially lower on poor sites than on medium sites.
- Three to 20 sprouts per plant have been produced within one season of cutting.
- Growth and number of sprouts are similar on clean-cut and shattered stumps.
- Sprouts have grown at the same rate regardless of the season of cutting in the wetter ICH subzones.

Chemical Treatments

- Both glyphosate and 2,4-D have successfully controlled these alders.
- Glyphosate has effectively controlled Sitka alder when applied at rates of 1.26–1.76 kg a.i./ha in the Penticton District and 2.14 kg a.i./ha on a submesic ESSFwm site near Lillooet.
- Limited results suggest that glyphosate applications made in September are ineffective.
- Drought stress increases the resistance of Sitka alder to glyphosate.
- Hexazinone applied to cut stumps provides good sprouting control.
- 2,4-D amine applied to fresh stumps has provided moderately good control of sprouting. Most treated stumps are killed and those that sprout do so with reduced vigour.

Mechanical Site Preparation

- These alders often colonize recently disturbed soil such as skid trails on logged sites.
- Neither species seeds-in as aggressively as red alder does.
- Sprouting can be expected from root crowns and stem bases that are damaged during mechanical site preparation.
- Treatments that uproot the species will probably reduce their frequency.

SITKA ALDER/GREEN ALDER

Prescribed Burning

- Sitka alder can rapidly establish after burning. Reproduction occurs through seeding-in and sprouting from root crowns.
- Several studies indicate that frequency and cover is increased after repeated burning.
- Moderate to severe burns have successfully controlled established Sitka alder for 5–7 years in some moist subzones of the SBS and ESSF zones.

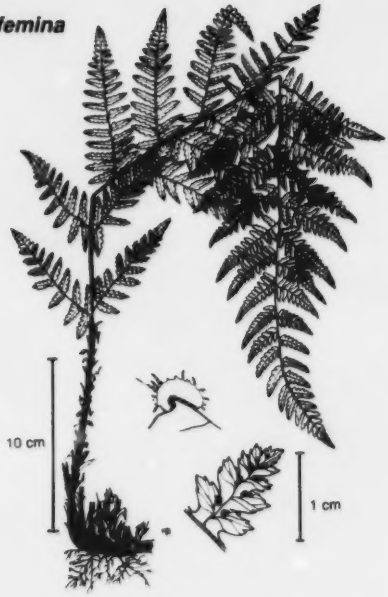
Other Treatments

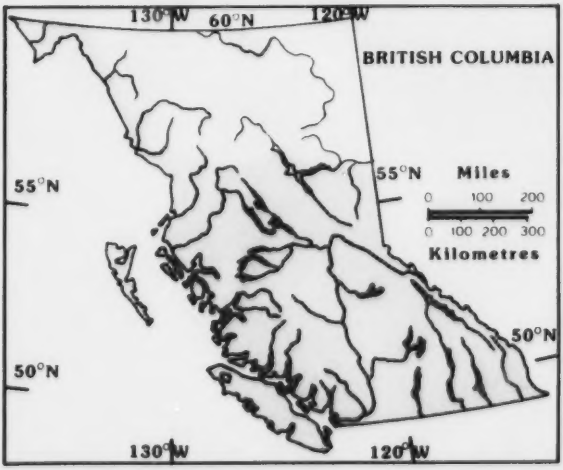
- Brown (using glyposate)-and-burn treatments have effectively controlled Sitka alder.

Wildlife Values

- Sitka and green alder have relatively low browse value for ungulates.
- White-tailed deer and mule deer feed on the leaves and twigs and elk browse on the young shoots.
- Sitka alder is a major food of snowshoe hares.
- Squirrels readily consume catkins and birds eat cones, buds and seeds.

Athyrium filix-femina
(lady fern)





Distribution of *A. filix-femina* in British Columbia.

Overstory Removal
- On subhygric and wetter sites and in areas of high summer precipitation, lady fern remains vigorous and tends to increase slightly in abundance and cover following canopy removal.
- On sites prone to summer moisture stress following logging, lady fern tends to lose vigour, and abundance and cover will decrease or remain static.

Manual Treatments
- No information.

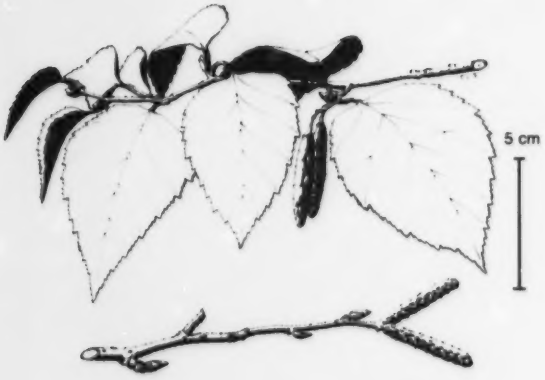
Chemical Treatments
- Glyphosate applied at 2.1 kg a.i./ha in a broadcast spray between late July and early September has provided a high degree of top-kill in lady fern.
- Plants often completely recover within two to three seasons of herbicide application.

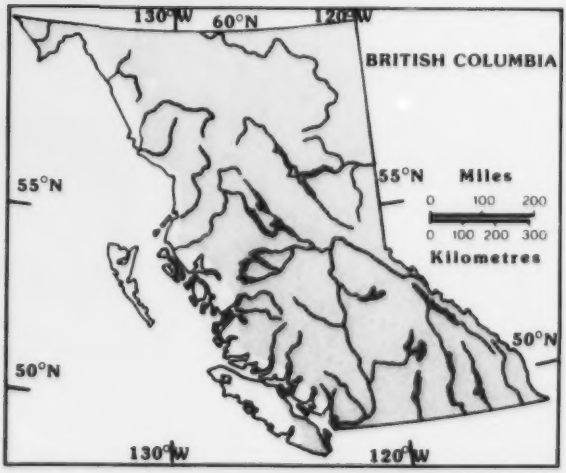
Mechanical Site Preparation
- Mounding has controlled lady fern for 5 years.

Prescribed Burning
- Burning usually completely kills lady fern or causes a significant reduction in cover. Control is more pronounced on dry sites and on sites with coarse textured soils.
- Lady fern has been stimulated by light burns on subhygric sites in the SBSvk subzone.
- Many sites with abundant lady fern are too wet for effective burns.

Wildlife Values
- Fiddleheads and mature fronds are readily eaten by black bear, grizzly bear and deer during spring and summer.
- Lady fern is moderately important winter food for deer, elk, moose and caribou.
- Blue grouse sometimes feed on lady fern.

Betula papyrifera
(paper birch)





Distribution of *B. papyrifera* in British Columbia.

Overstory Removal

- Sprouting often occurs at the base of trees left standing following harvesting of conifers in mixed stands.
- Sprouting vigour of mature trees cut during harvesting is variable and depends on site conditions.
- Sprout mortality is high.
- Rapid seeding-in occurs in areas of exposed mineral soil.
- Felling birch seed trees greatly reduces the number of seedlings.

Manual Treatments

- Paper birch sprouts from either the root collar or the stump following cutting. It is not uncommon for six or seven sprouts to appear for every cut stem.
- Sprouting is believed to be more vigorous if trees are cut during the dormant season.
- Birch sprouts typically grow 1.5–2.5 m/yr following cutting in the ICHmw and IDFmw subzones.
- Girdling has been effective in all seasons.
- Girdled trees sprout. Sprout number and vigour are variable. Girdled trees often produce fewer sprouts than cut trees.
- Double-frilled girdles or notched girdles are needed to ensure a high rate of top mortality.

Chemical Treatments

- 2,4-D ester, applied as an early foliar spray at a rate of 2.1 kg a.i./ha, and glyphosate, applied as a late foliar spray at 2.1 kg a.i./ha have provided good control of paper birch. Hexazinone applied as a broadcast spray at 2.2–4.3 kg a.i./ha in May generally provides good to excellent control of birch. Injury after 2 years is about 50% lower at the lower application rate than at the higher rate. Garlon® foliar sprays have also successfully controlled paper birch.
- Spot applications of hexazinone in May and June have effectively controlled birch.
- Hack-and-squirt treatments with glyphosate or 2,4-D provide good control. Birch bark frequently splits making this treatment difficult.
- Birch of all ages is susceptible to cut surface treatments of glyphosate.

Mechanical Site Preparation

- Mechanical treatments that incorporate mineral soil and organic layers and expose areas of mineral soil provide excellent conditions for the germination and survival of paper birch seedlings.

Prescribed Burning

- Seedlings are generally more frequent on burned than on unburned areas.

PAPER BIRCH

- Birch mainly establishes on mineral soil on burned sites and generally does not seed-in to burned LFH layers.
- Burned stumps sprout less than unburned ones.
- Burns of moderate severity will kill standing paper birch trees.
- Sprouting is common on trees damaged or killed by fire; sprouts are less frequent on middle-aged and old trees than in young stands.

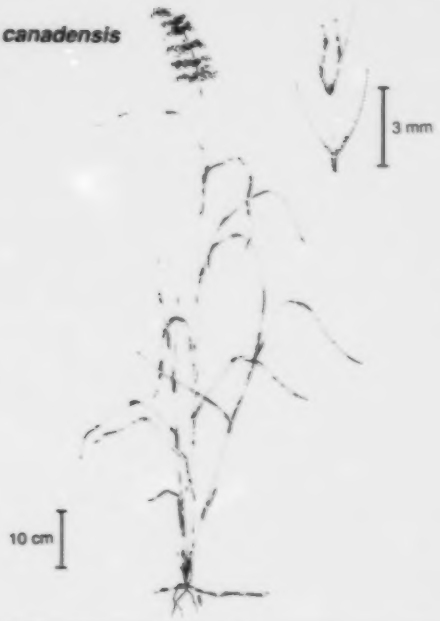
Other Treatments

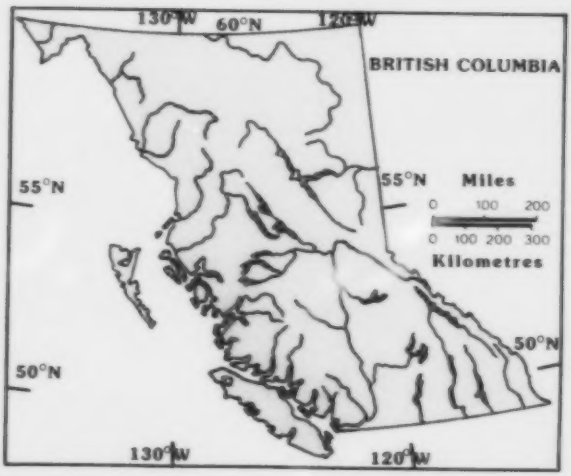
- Winter cutting followed 1 year later by a low severity spring burn sharply reduced the number of sprouts compared to cutting alone. The cut-and-burn treatment eliminated stump resprouting, but approximately 75% of stems resprouted from the root collar.
- Paper birch seedling height and biomass have been significantly increased with the addition of N-P-K fertilizer.

Wildlife Values

- Paper birch is highly palatable to wildlife.
- In some areas, birch is very important for moose.
- The species is a moderately important winter browse for mule deer, Rocky Mountain elk, caribou and mountain goat.
- Paper birch sprouts vigorously after browsing.
- Paper birch is a preferred food of many small mammals including snowshoe hare, porcupine and beaver.
- Birds feed on the buds, catkins and seeds.
- Paper birch is an important nesting tree for birds including woodpeckers, owls, hawks, sapsuckers, flycatchers and vireos.

Calamagrostis canadensis
(bluejoint)





Distribution of *C. canadensis* in British Columbia.

Overstory Removal

- On sites where bluejoint is present before harvesting it will usually increase rapidly by rhizomatous growth following canopy removal. The fastest increases are on areas of soil disturbance and compaction.
- Bluejoint is an aggressive colonizer of boreal sites.
- Bluejoint increased in cover from 20 to 70–90%, and increased in height from 40 to 130 cm within 3 years of clearcutting a BWBSmw site in the Fort St. John District.
- On sites where bluejoint is not present before the harvest, it can rapidly invade by wind-dispersed seed.
- Continuous sods of the grass can form within 3 or 4 years of logging.

Manual Treatments

- Manual cutting will not control bluejoint.
- Bluejoint does not tolerate heavy cutting; yields decreased by 20% when the grass was cut 2–4 times during the growing season and by 70% when cut 7 times during the growing season.

Chemical Treatments

- Glyphosate applied as a foliar spray at rates of 2.1 kg a.i./ha has controlled bluejoint for upto two growing seasons.
- Glyphosate may be more effective when applied in the late summer rather than the early summer.
- An early August application of 1.3 kg a.i./ha of glyphosate to a BWBSmw site in the Fort St. John District resulted in 98% kill in the first growing season, but grass reinvaded the following growing season.
- Hexazinone applied as a liquid spray at 1.1 kg a.i./ha has provided excellent control of bluejoint.
- Hexazinone gridballs applied aerially at 4 kg a.i./ha in spring have maintained excellent control for 5 years after treatment.
- Simazine may provide good control.
- Bluejoint often invades after other plant species have been killed or set back by herbicides.

Mechanical Site Preparation

- Bluejoint can regain a dense cover 1–3 years after scarification.
- Manually cleared scalps 30 x 30 cm in size were approximately 50% reinvaded by grass after 1 year on a site near Edson, Alberta.
- Plowing provides effective control of established plants, but the disturbed areas are then subject to seed-in by adjacent untreated plants.
- Intense 30 cm deep cultivation with the Madge Rotoclear controlled bluejoint for only one growing season in the BWBSmw subzone near Fort St. John, B.C.

BLUEJOINT

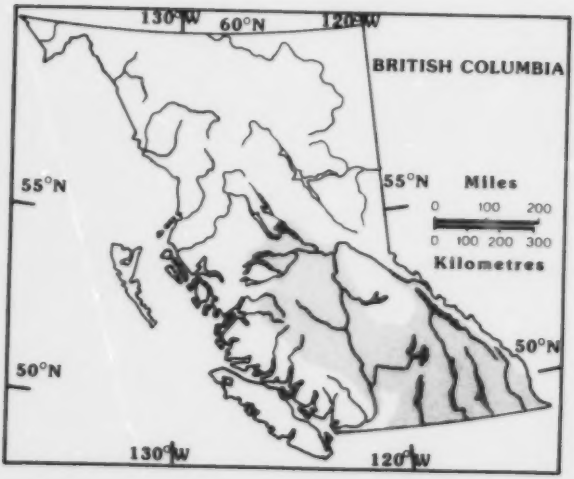
Prescribed Burning

- Cover increases more rapidly on burned than on unburned areas.
- Fire stimulates rhizomatous sprouting and can favour reproduction from seed by creating favourable seedbeds.
- Substantial increases in bluejoint cover can occur following burning.
- Expect increases to be greatest on wet to moist sites.

Wildlife and Range Values

- Importance to ungulates is generally low.
- Rocky Mountain elk make low to moderate use of the grass as winter and spring food.
- Snowshoe hares may consume limited amounts.
- Bluejoint is moderately palatable to domestic livestock.
- The grass withstands heavy grazing.

Calamagrostis rubescens
(pinegrass)



Distribution of *C. rubescens* in British Columbia.

Overstory Removal

- The species increases in abundance, vigour, and seed production following harvesting or thinning.
- Abundance often increases dramatically after logging. The loose grass turf under forest stands can quickly develop into a continuous grass sod.

Manual Treatments

- Grazing and clipping will control pinegrass, but the benefits of these treatments to conifer seedlings are likely outweighed by the effort required.
- Plants are most sensitive to clipping in July.

Chemical Treatments

- Glyphosate provides good control of pinegrass for 2–3 years.
- Glyphosate is effective when applied in the active growing season (May and June) or later in the growing season (August).
- Hexazinone has provided good control at 2.2 kg a.i./ha in Washington and Oregon.
- Simazine has proven to be an effective chemical for control of pinegrass in trials conducted in the Kamloops Forest Region.

Mechanical Site Preparation

- Light to medium soil disturbance favours pinegrass. Lightly disturbed areas can become completely overgrown within one growing season.
- Anchor chain drag scarification can significantly increase pinegrass abundance and cover; cover is generally reduced for only two growing seasons.
- Disc trenching or patch scarification can be used to reduce pinegrass competition, but control will be short-lived.
- Severe mechanical disturbance retards pinegrass invasion for 3–5 years.

Prescribed Burning

- Cover increases more rapidly on burned areas than on unburned areas.
- Pinegrass can increase rapidly by rhizomatous sprouting during the first growing season and by sprouting and seeding-in during subsequent growing seasons.
- Repeated light fires promote the greatest increase in cover.

Other Treatments

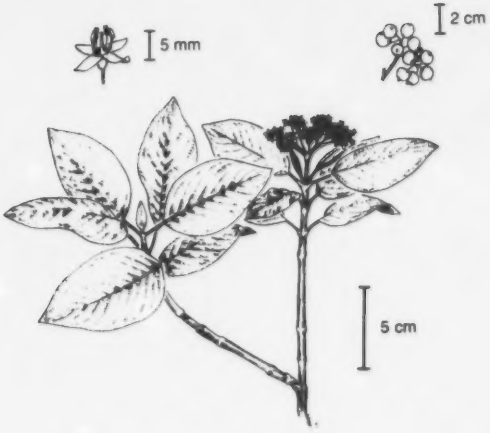
- Fertilization with nitrogen can dramatically increase pinegrass cover and vigour.
- Pinegrass is susceptible to heavy grazing.

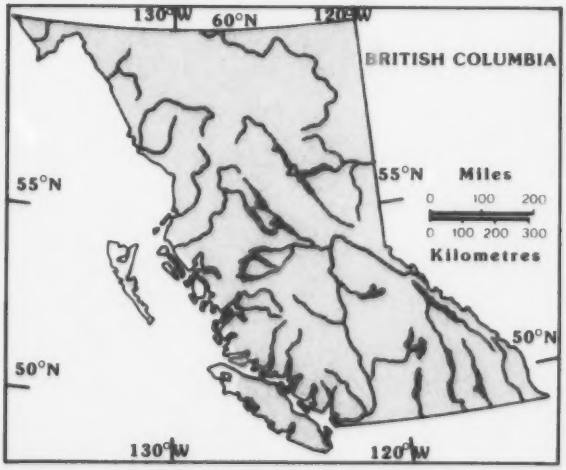
PINEGRASS

Wildlife and Range Values

- Pinegrass is valuable forage for Rocky Mountain elk in the western United States and Canada; importance is highest in March and April.
- Pinegrass is important early spring forage for mule deer.
- Cattle have low to medium preference for pinegrass in early summer and low preference later in the summer.
- Because pinegrass is abundant, it is widely used for cattle grazing in the Interior.

Cornus sericea
(red-osier dogwood)





Distribution of *C. sericea* in British Columbia.

***Cornus sericea* L.** **RED-OSIER DOGWOOD**
(C. stolonifera)

Overstory Removal
- The species neither increases nor decreases dramatically following harvesting.
- Individual plants will usually become bushier.
- Cover increases slowly over time, especially on productive sites.

Manual Treatments
- Plants grew 60 cm in height 1 year after manual cutting on a productive site in the southern Interior of B.C.
- Cutting early in the growing season can produce more sprouts than treatments undertaken during the dormant season.

Chemical Treatments
- Red-osier dogwood is partially resistant to summer and fall applications of glyphosate, hexazinone, and the other herbicides registered for forestry use in B.C.
- Early foliar applications of glyphosate at 2.1 kg a.i./ha can give effective short-term control of red-osier dogwood.
- In Oregon, 2,4-D was more effective when applied early in the growing season than when applied as the plant approached dormancy. Nearly all plants survived, but those sprayed earlier in the year were more chlorotic and deformed.

Mechanical Site Preparation
- Damaged plants may sprout or sucker from roots and stem bases.
- Broken stem parts that are incorporated into the mineral soil may root and subsequently produce aerial shoots.
- Some seeding-in may occur in areas of exposed mineral soil.
- Any change in cover following mechanical site preparation is unlikely to be dramatic unless plants are physically uprooted from the site.

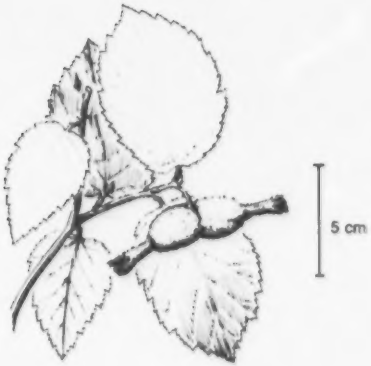
Prescribed Burning
- Sites where the species usually occurs are often too wet to burn.
- Red-osier dogwood is a seed-banking species. Regeneration from seed is favoured by fires of low severity and short duration that remove little of the surface organic matter. Prolific germination of stored seed is unlikely to occur.
- Fires of low severity will stimulate sprouting and rejuvenate the shrub, but will not necessarily result in a rapid increase in abundance or cover.
- Severe fires that destroy the underground parts can dramatically set back this species and result in slow recovery.

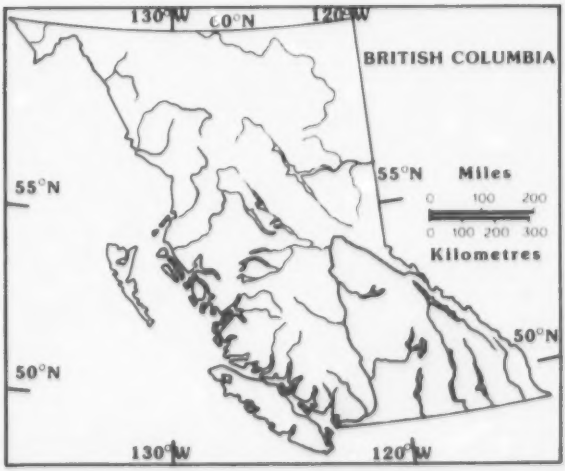
RED-OSIER DOGWOOD

Wildlife and Range Values

- Red-osier dogwood is a highly important food for wildlife in B.C., especially deer, moose and birds.
- The shrub is a very important winter browse for Roosevelt elk, moose and mountain goat and a moderately important browse for Rocky Mountain elk, caribou, and Interior and coastal deer species.
- New shoots and the fruit are the most commonly consumed parts of the plant.
- Small mammals that forage on this plant include snowshoe hare, beaver and chipmunk.
- Black bears, grizzly bears and numerous bird species feed on the fruit.
- The shrub provides nesting sites for birds.
- Wildlife browsing induces sprouting and an increase in density, but heavy, repeated browsing retards growth.
- Cattle have a low to medium preference for red-osier dogwood.
- Wildlife browsing induces sprouting and an increase in density.

Corylus cornuta
(beaked hazelnut)





Distribution of *C. cornuta* in British Columbia.

Overstory Removal

- Individual plants or clumps usually become more vigorous after overstory removal.
- Expect a gradual increase in abundance and cover through sprouting and suckering.
- Hazelnut is very slow to invade areas where it is not present before logging.

Manual Treatments

- Manual control is not considered an effective means of reducing hazelnut cover.
- Hazelnut sprouts prolifically following cutting and generally produces two to four sprouts per cut stem. Its ability to sprout is not significantly affected by repeated cuttings. Sprouts can grow 1–1.5 m in the first year.
- Suckering may also occur following cutting.
- There was less sprouting when cutting took place late in the growing season than when cutting occurred during the early foliar or dormant stages.

Chemical Treatments

- Glyphosate has provided effective control of hazelnut. In B.C., a late summer broadcast application of glyphosate at 1.7 kg a.i./ha reduced hazelnut cover by 90% and completely killed about half of the plants. Foliar treatments of glyphosate during the spring, late summer, and fall have caused severe to very severe injury to hazelnut in Washington and Oregon.
- Hexazinone applied by broadcast or spot application has caused only light injury to hazelnut.
- 2,4-D produces heavy top-kill in hazelnut, but resprouting can be vigorous.
- Amitrol applied in summer has caused moderate injury in western Washington and Oregon.
- If sprouting occurs following chemical treatment, it often does not take place until the second growing season.
- Double treatments (in which a second spray is applied to sprouts 2 years after the original application) can result in total control.

Mechanical Site Preparation

- Unless mechanical treatments destroy or remove underground stems, hazelnut will sprout back and its stem density will increase in the long run.
- Both disc trenching and deep scarification with a brush blade have been successful in reducing the abundance and cover of hazelnut.

BEAKED HAZELNUT

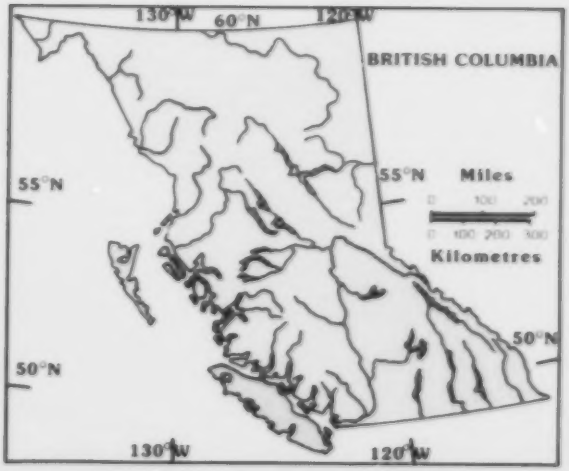
Prescribed Burning

- Aerial stems are killed regardless of fire intensity.
- Burning is followed by vigorous sprouting and suckering. Within a few years most stands will replace themselves with an increase in stem density over preburn levels.
- Destruction of hazelnut from burning of underground stems and roots is unlikely under all but the most extreme conditions of fuel and weather.
- Repeated summer burns can eradicate the plant; repeated spring burns will simply increase the number of stems.

Wildlife Values

- In some locations, hazelnut is a preferred winter browse species for mule deer, white-tailed deer and moose.
- Deer or moose browsing can stimulate basal sprouting or suckering and result in considerable increases in available browse.
- Some birds and many small rodents (e.g., squirrels and chipmunks) value the nuts for food.
- Hazelnuts are also an important food of snowshoe hares.

Epilobium angustifolium
(fireweed)



Distribution of *E. angustifolium* in British Columbia.

Overstory Removal

- Fireweed aggressively colonizes logged-over areas where ground disturbance has occurred.
- Colonization is achieved primarily by the seeding-in of airborne seeds, but where fireweed already exists before canopy removal, it is able to expand by means of its spreading root system.
- Once established it can become the dominant species on the site within 1 or 2 years.
- Maximum cover of fireweed is usually achieved within 3–5 years of harvesting.
- Fireweed tends to achieve higher densities on sites in the interior of B.C. than on the coast.
- Although fireweed can rapidly exploit a vacant niche, it is unable to compete where vegetation is already well established.

Manual Treatments

- Because the entire aerial shoot dies at the end of each growing season, manual treatments are only effective in reducing competition and mechanical damage during the remainder of the growing season in which cutting took place.
- Cutting stimulates sprouting from stem bases and the production of new root suckers.
- Fireweed cut in late June on two rich mesic ICH sites regrew 10–65 cm in height after 60 days.

Chemical Treatments

- Chemicals must act on the extensive root system to be effective.
- Glyphosate severely injures fireweed and is usually successful in providing short-term control.
- Broadcast applications of 0.6 kg a.i./ha of glyphosate have reduced fireweed cover by 60–100%.
- Pre-treatment cover is almost always regained 2–3 growing seasons after glyphosate applications.
- One study found that spring applications of glyphosate resulted in complete recovery of fireweed cover after 1 year, while fall applications provided good control for at least 3 years.
- Broadcast applications of 1–2 kg a.i./ha liquid hexazinone have tended to give unsatisfactory control, while rates of 3.0–4.3 kg a.i./ha have often resulted in good control, especially at the highest rates.
- Spot applications of hexazinone have provided variable control; best control has generally resulted from a rate of 8 mL/spot and 2-m spacing.
- Fireweed is susceptible to simazine.

FIREWEED

Mechanical Site Preparation

- Mechanical site preparation alone is not considered to be an effective means of controlling fireweed.
- Seeds readily germinate in exposed mineral soil.
- Fragmentation of the root system produces many new plants and stimulates production of new shoots.
- Fireweed is slow to invade sites with nutrient-rich topsoil removed, such as deep brush blade tracks and skid trails.

Prescribed Burning

- Fireweed is highly favoured by burning and is more abundant on burned than on unburned sites.
- Fireweed is more abundant on moderately burned sites than on lightly burned sites, but the response to fire severity seems to vary from site to site.
- Burning favours fireweed by reducing competition from other plants and providing a suitable seedbed.
- Both seeding-in and vegetative reproduction are prominent means of fireweed invasion following burning.
- Fireweed cover generally increases to a maximum within a few years of burning, then either declines or remains static.
- The longevity of fireweed dominance after fire depends on the rate of development of other herb and shrub species and on nutrient availability.
- Fireweed may not survive well under regimes of regular, frequent burning.

Other Treatments

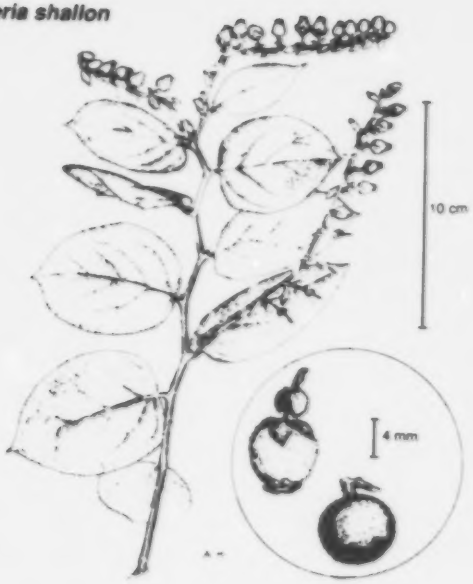
- Areas seeded to grass or legume species have lower cover and frequency of fireweed than control areas.
- Fireweed increases in abundance where fertilizers are used in silviculture. Fireweed germination on fertilized sites is highest when vegetative cover is lacking. When plant cover is well established on a site, fertilization will not increase germination of fireweed.
- Operational experience indicates that brown-and-burn treatments result in rapid recovery of fireweed within 2 years.
- Sheep can be used to control fireweed. The plant is susceptible to heavy or continued grazing.

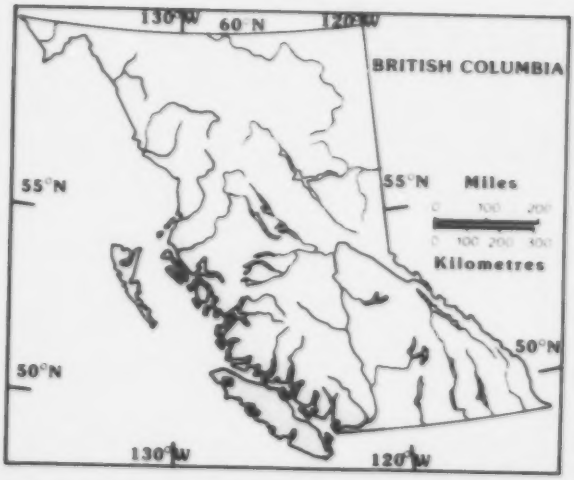
Wildlife and Range Values

- Importance as food for wildlife is moderate.
- Fireweed can be an important browse for all species of deer in B.C.
- The plant has medium to low importance as a summer and fall food for moose, and has moderate importance in the diet of Roosevelt elk.

- Seeds are eaten by many small mammals including pikas, squirrels and heather voles.
- Fireweed colonies provide habitat for many small mammals including mice, voles, shrews and chipmunks.
- Fireweed is susceptible to heavy or continued grazing. Sheep can be used to control the plant.
- Cattle have a low grazing preference for fireweed.

Gaultheria shallon
(salal)





Distribution of *G. shallon* in British Columbia.

Overstory Removal

- Overstory canopy closure of at least 80% is needed to shade out salal completely.
- Salal does not increase or decrease significantly in cover immediately following logging, but below-ground plant parts may rapidly increase in abundance.
- Logging disturbance or damage stimulates sprouting.
- Abundance and cover gradually increase over time and the plant can become the dominant species on many sites.
- Thinning will cause an increase in the vigour and cover of a salal understory if the amount of light penetrating the canopy increases significantly.

Manual Treatments

- Regrowth following cutting is slow. The extent and speed of recovery depend on the size and vigour of the plant at the time of treatment.
- Salal normally takes 1–4 years to return to pretreatment levels following cutting.
- Cutting causes an increase in stem density.

Chemical Treatments

- Foliar applications of Garlon® in diesel have provided effective control of salal.
- Glyphosate causes minimal to moderate damage.
- Following applications of glyphosate, salal has been observed to invade areas left vacant by susceptible plants.
- Hexazinone tends to be ineffective at controlling salal, although good control has occasionally been obtained.
- Herbicides in diesel or oil-in-water carriers have been more effective because of their ability to penetrate the thick waxy leaves and the bark. Bud break sprays have been more successful than foliar sprays.

Mechanical Site Preparation

- Treatments using brush rakes, straight and V-shaped blades, and backhoes to break up the root system and retard growth have produced variable results.
- Backhoe site preparation (mixing organic and mineral soil layers) on a mesic site in the Queen Charlotte Islands initially reduced salal cover, but within 3 years it was rapidly reinvading.
- Heavy scarification in the CDF and CWH zones on Vancouver Island has resulted in very slow reinvasion of salal.
- Fragmentation of the root and rhizome system can result in an increase in the number of plants on the site.

Prescribed Burning

- Severe burns reduce sprouting; light burns increase sprouting and increase cover above pre-burn levels.
- Burning successfully controls salal on dry sites where heat penetrates the soil and kills underground parts. A severe burn on a dry site can eliminate the species but is unlikely to do so without causing site degradation. Burning is less effective in controlling salal on moist sites.
- The below-ground environment is usually fully occupied by salal within 8 years of logging and burning old-growth cedar-hemlock sites in the CWH zone.

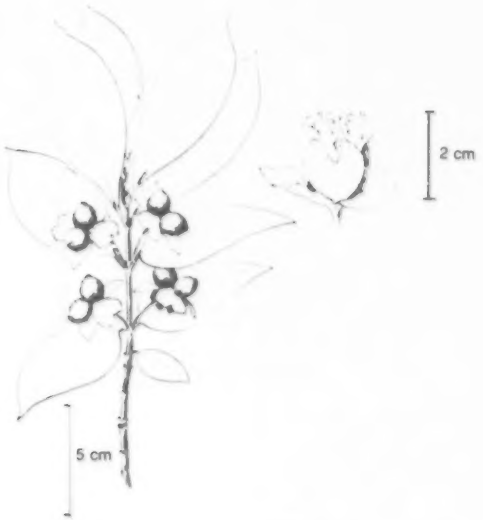
Other Treatments

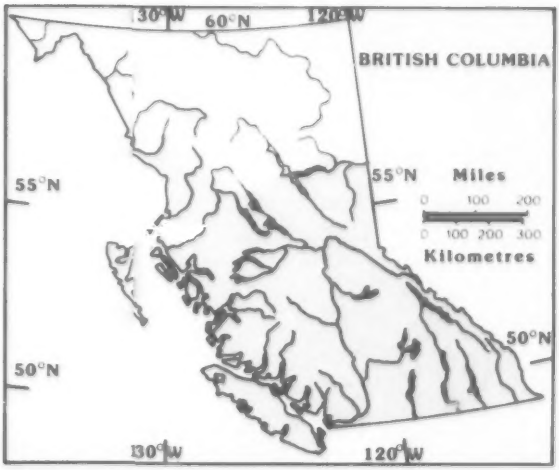
- Nitrogen fertilization is likely to increase leaf production and plant biomass, but does not usually stimulate major increases in shoot and root growth.

Wildlife Values

- Salal is important for wildlife in B.C.
- Salal is valuable black-tailed deer forage year-round, and is particularly important in winter.
- Salal is an important winter and spring food for Roosevelt elk.
- Some small mammals and birds browse on salal.
- Berries are consumed by grouse and other birds, black bear, black-tailed deer and squirrels. Birds and mammals play an important role in seed dispersal.
- In Oregon and Washington, mountain beaver often use salal for their nests.

Lonicera involucrata
(black twinberry)





Distribution of *L. involucrata* in British Columbia.

Lonicera involucrata **BLACK TWINBERRY**
(Rich.) Banks

Overstory Removal
- Abundance and cover will remain constant or increase following harvesting. Expect an increase on moist, productive sites.
- The crowns of individual plants usually fill out and become bushier following canopy removal.
- Seeding-in may occur on some sites.

Manual Treatments
- Sprouting, and possibly suckering, will occur following cutting.

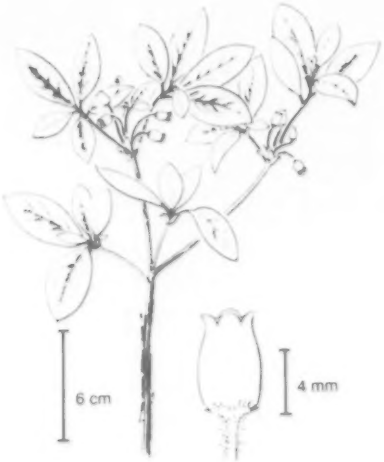
Chemical Treatments
- Glyphosate applied as a foliar spray at rates of 2.1 kg a.i./ha provides moderate to complete control.
- Hexazinone has caused variable injury to black twinberry in B.C.

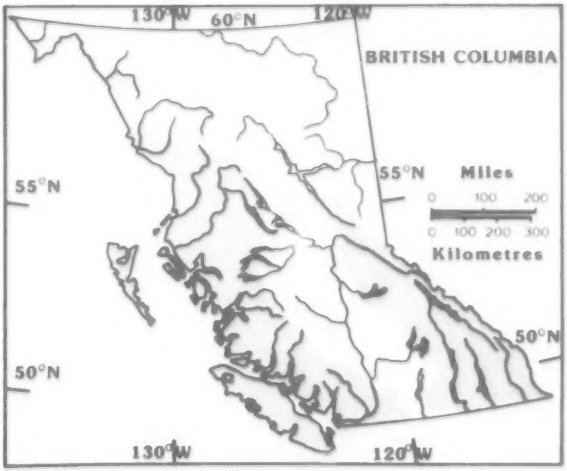
Mechanical Site Preparation
- Because this species is a seed-banker, soil disturbance may stimulate germination of stored seed.
- Breaking up the root system with a discing or ripping treatment may help control twinberry.

Prescribed Burning
- Severe fires result in slow recovery or elimination of the species.
- Light burns stimulate vigorous resprouting.

Wildlife Values
- Black twinberry is not a common browse species in B.C., but it is a moderately important winter food for moose and Roosevelt elk.
- Berries provide summer food for birds, black and grizzly bears, and other mammals.

Menziesia ferruginea
(false azalea)





Distribution of *M. ferruginea* in British Columbia.

Overstory Removal
- Response of false azalea to overstory removal depends on the degree of ground disturbance.
- Abundance and cover remain fairly constant following winter logging (on snow).
- Summer logging typically damages false azalea and results in slow recovery.
- If there are no further treatments following canopy removal, a gradual increase in cover will occur until the plant is overtopped by trees.

Manual Treatments
- False azalea sprouts from the stem base following cutting.
- Sprouts have low vigour on harsh sites, and cutting effectively controls aboveground plant parts.
- Sprouts were 30 cm tall one year after cutting in the ESSFwc subzone. Sprouts grew 40 cm the year following manual cutting in the Penticton District.
- Multiple cuttings do not depress sprout vigour.

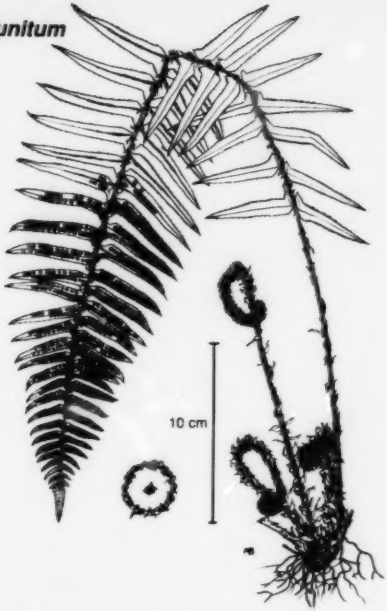
Chemical Treatments
- Glyphosate applied as a broadcast spray of 4–6 L/ha in late summer has consistently provided at least 2 years of control in B.C.
- Plants in the ESSFwc subzone near Blue River, B.C., sprouted weakly after a 2.1 kg a.i./ha application of glyphosate, and sprouted vigorously after a 0.7 kg a.i./ha application.
- In a trial near Blue River, false azalea remained dwarfed and deformed 2 years after a late July glyphosate application by Micron Herbi at 0.5 kg a.i./ha.

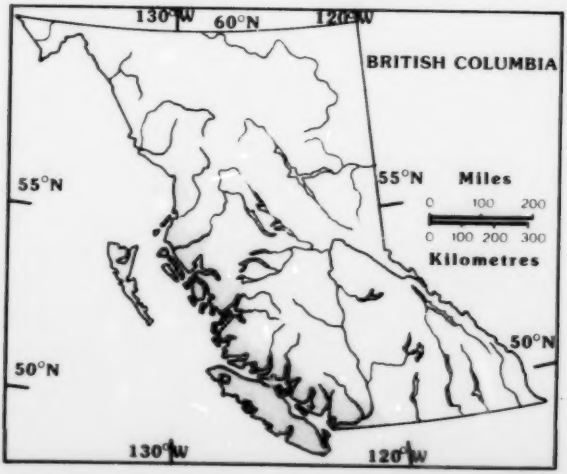
Mechanical Site Preparation
- Damaged stems are expected to sprout.
- Mechanical site preparation can control false azalea for 15 or more years on harsh ESSF sites.
- Seeding-in is unlikely to be significant.

Prescribed Burning
- Survival is low following severe burns. Regrowth of surviving plants is slow and cover can remain significantly below pre-burn levels for 15 or more years.
- Sprouting from stumps is common following light to moderate burns.

Wildlife Values
- The species is not considered to be important for most ungulates except black-tailed deer and Roosevelt elk.

Polystichum munitum
(sword fern)





Distribution of *P. munitum* in British Columbia.

Overstory Removal

- Numerous studies have monitored the response of sword fern following canopy removal. Results have been variable, but no studies report a dramatic change in abundance or cover.
- Sword fern will probably maintain or increase its cover and vigour on those sites where it does not experience significant summer moisture stress.

Manual Treatments

- Manual cutting alone will not cause plant mortality.

Chemical Treatments

- Glyphosate is reported to cause very severe injury to sword fern in B.C.
- Sword fern was significantly controlled but not eliminated one growing season after an early September broadcast application of 1.4 kg a.i./ha glyphosate in the Campbell River District.
- Expect hexazinone to cause moderate injury.
- 2,4-D applied in the winter or amitrol applied in the spring have provided poor control of sword fern in western Washington and Oregon.

Mechanical Site Preparation

- Techniques that remove the plant from the ground will result in nearly total elimination of the species from the site.
- Brush blade scarification totally eliminated sword fern from a study site in Oregon.
- Sword fern was only present on undisturbed microsites following scarification of several sites near Vancouver, B.C.

Prescribed Burning

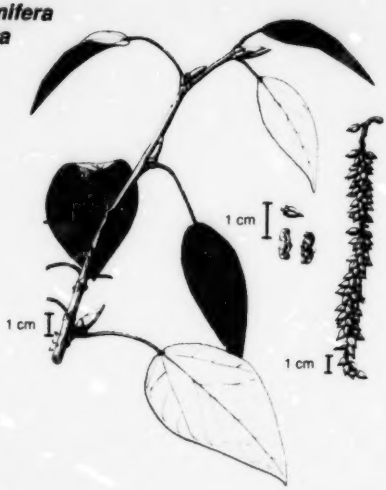
- Variable responses to burning have been reported.
- Fire severity and local site conditions are probably the most important factors controlling sword fern response. Severe fires on dry or shallow soils will eliminate or dramatically reduce sword fern cover and frequency.
- Most studies report a decrease in frequency following burning. Recovery is slow.
- On moist sites, burning may stimulate vigorous resprouting, resulting in an increase over pre-burn levels. An Oregon study reported that sword fern cover gradually increased in cover for 30 years after burning.

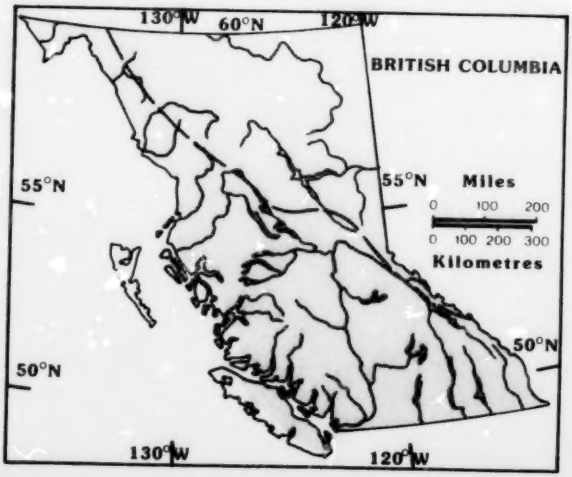
SWORD FERN

Wildlife Values

- Extensive use usually occurs only when animal populations reach high densities and preferred foods are limited.
- Sword fern is a moderately important food for black-tailed deer year-round and can also be moderately important for Roosevelt elk.
- Black bears forage on sword fern.
- Sword fern is an important winter food for mountain beaver in Oregon.

Populus balsamifera* ssp. *balsamifera
(balsam poplar)





Distribution of *P. balsamifera* in British Columbia. The dashed line indicates the approximate boundary between ssp. *balsamifera* (balsam poplar) to the north and east, and ssp. *trichocarpa* (black cottonwood) to the south and west. Specimens intermediate between the two subspecies are common where their ranges overlap.

Overstory Removal

- Balsam poplar is normally part of the overstory canopy and may be cut during logging or left standing. In either case, the number of stems can increase dramatically following harvesting.
- An Alaskan study monitoring regeneration following summer, fall and winter logging of mature balsam poplar found:
  1. More than 50% of the stumps produced sprouts regardless of cutting season.
  2. Stump sprouting was most pronounced on winter-logged areas.
  3. An individual stump can produce as many as 50–60 sprouts.
  4. Sprout mortality was low on fall- and winter-logged areas.
  5. On the summer-logged areas only 15% of the stumps still had live sprouts after 4 years.
  6. Root suckering occurred on all areas; soil disturbance enhanced suckering.
- Other forms of regeneration not described above include regeneration of buried branch pieces and seeding-in on areas of exposed mineral soil.
- Suckering is probably the dominant form of regeneration, but seedling establishment is also common.

Manual Treatments

- Balsam poplar responded to girdling in a similar manner to aspen in the BWBS zone in the Fort St. John District. Girdling is apparently effective in all seasons.

Chemical Treatments

- Hexazinone applied as a liquid spray, by soil injection, or by granular application has generally provided good control. Variable results have occurred on areas with deep organic layers.
- Mature balsam poplar is resistant to 2,4-D, but 1- or 2-year-old suckers may be more susceptible.

Mechanical Site Preparation

- Mechanical site preparation that exposes mineral soil results in an excellent seedbed for balsam poplar seed.
- Only freshly deposited seed will germinate.
- Exposing mineral soil will promote suckering of residual balsam poplar.
- Branch fragments buried during soil disturbance are likely to regenerate.

BALSAM POPLAR

Prescribed Burning

- Burning will stimulate root suckering and prepare a good seedbed for seedling establishment.
- Suckering may be most intense in the second year after burning.
- Burned areas generally have greater densities of balsam poplar than unburned areas.

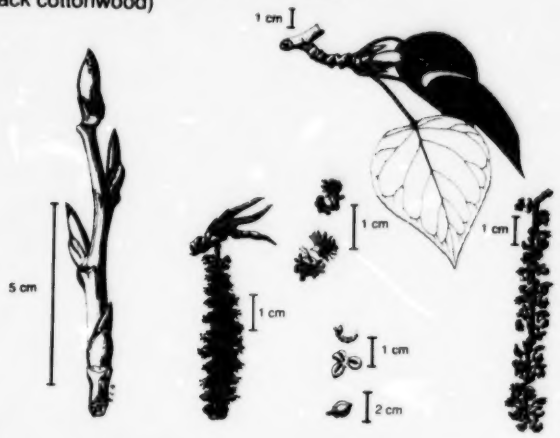
Other Treatments

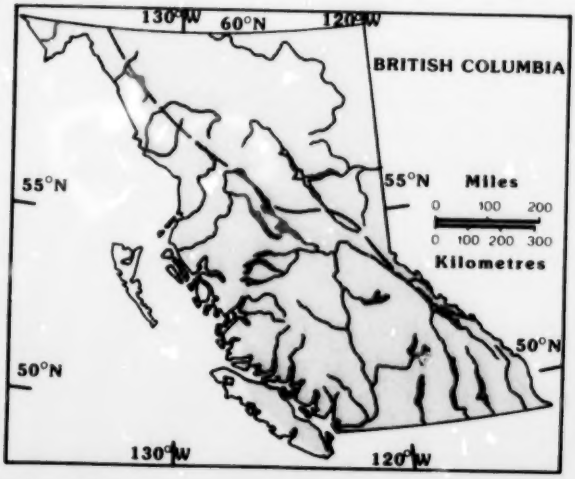
- Burning of young poplars, followed by a mid-summer spray of the resulting suckers with 2,4-D ester, has provided better control than either burning or spraying alone.

Wildlife Values

- Balsam poplar is a moderately important winter food for mule deer, moose and Rocky Mountain elk, and is a common food for beaver.
- Snowshoe hares browse heavily on balsam poplar in Alaska.
- Many bird species rest or perch in balsam poplar trees.

Populus balsamifera* ssp. *trichocarpa
(black cottonwood)





Distribution of *P. balsamifera* in British Columbia. The dashed line indicates the approximate boundary between ssp. *balsamifera* (balsam poplar) to the north and east, and ssp. *trichocarpa* (black cottonwood) to the south and west. Specimens intermediate between the two subspecies are common where their ranges overlap.

***Populus balsamifera* L. ssp. *trichocarpa* (Torr. & Gray) Braysh.** **BLACK COTTONWOOD**

Overstory Removal

- Logging of mature black cottonwood will produce vigorous stump sprouts.
- Cottonwood sprouts usually grow faster than any other vegetation on a newly logged site.
- Broken stem or root parts incorporated into the soil during logging operations may regenerate.
- Rapid seeding-in may occur on areas of disturbed mineral soil. Cottonwood produces a large seed crop every year.
- Seed disperses over long distances and, therefore, removing all standing trees does not guarantee against seeding-in.

Manual Treatments

- Manual treatments are not considered to be an effective means of reducing cottonwood frequency and cover.
- Cottonwood will sprout vigorously regardless of the season in which it is cut. Sprouting tends to be less if cutting takes place during the growing season. In one study, maximum sprouting occurred on stems cut between November and February.
- Cottonwood continues to sprout vigorously even after repeated cutting (e.g., 5 times in 10 years).
- Cutting height and angle do not appear to affect initial sprouting vigour.
- In one study, mid-summer cutting of 4-year-old cottonwood provided effective control for 2 years because the cut stumps were shaded by salmonberry and therefore did not resprout rapidly. On a nearby site that lacked shade, the same treatment resulted in rapid resprouting.

Chemical Treatments

- Cottonwood is extremely sensitive to summer or fall broadcast applications of glyphosate at rates of 1.0–2.1 kg a.i./ha.
- Broadcast applications of hexazinone have provided moderate to severe injury in B.C.
- 2,4-D ester causes some top-kill, with little lasting control.
- 2,4-D amine applied as a broadcast spray has resulted in light to moderate injury to black cottonwood in B.C.
- 2,4-D amine has severely injured black cottonwood when applied to cut surfaces in summer in Washington and Oregon.

BLACK COTTONWOOD

Mechanical Site Preparation

- Most types of mechanical site preparation will enhance black cottonwood.
- Treatments that expose areas of moist mineral soil create favourable environments for germination of seed from residual or nearby trees.
- Fragments of stems and roots incorporated into the mineral soil through site preparation readily regenerate in moist soil.

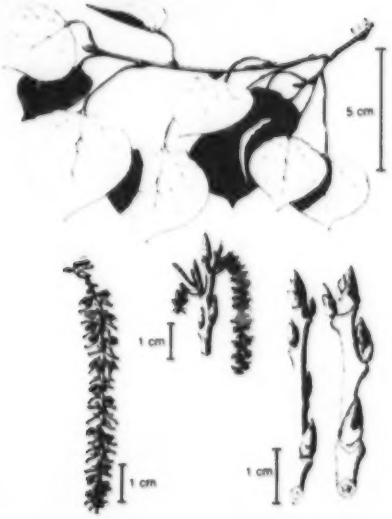
Prescribed Burning

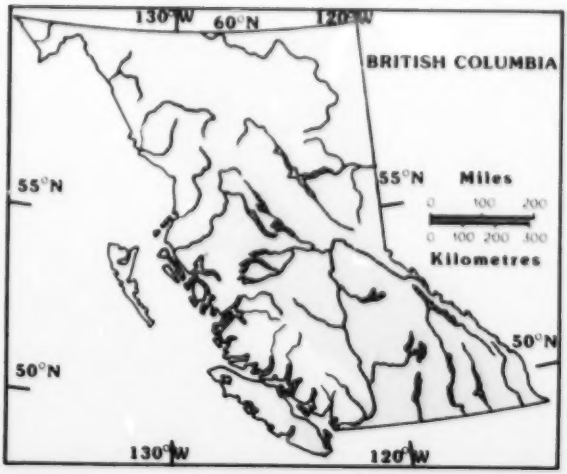
- Black cottonwood will sprout following burning.

Wildlife Values

- Black cottonwood is an important winter browse for Roosevelt elk, a moderately important winter and spring browse for moose, and a moderately important browse for white-tailed deer.
- Many small mammals, including voles, rabbits, hare, beaver and squirrels, feed on the tree.
- Small mammals, especially voles and meadow mice, can severely damage young trees on grassy or herb-covered sites.
- Rabbits and hares can cause damage by clipping twigs and girdling around stem bases.
- Ruffed grouse and pileated woodpeckers feed on black cottonwood.
- Black cottonwood is an important nesting tree for cavity-nesting birds and herons and it is important for daytime perching of bald eagles.

Populus tremuloides
(trembling aspen)





Distribution of *P. tremuloides* in British Columbia.

Overstory Removal

- Logging mature aspen results in profuse root suckering and a limited amount of stump sprouting.
- It is not uncommon to get 80 000 stems per hectare of aspen suckers in the first growing season following logging of a mature aspen stand. Sucker densities can reach 225 000 stems per hectare the first year after harvest.
- The density of suckers depends, at least in part, on the amount of soil disturbance accompanying harvesting operations.
- Aspen regeneration consists of frequent small clumps of extremely dense suckers. The intense competition between these suckers leads to rapid natural thinning. Insects, disease, browsing and snowpress also contribute to mortality. Within 10 years following overstory removal, a clump can be reduced to a single living stem.
- Suckers can grow up to 2 m in height during the first growing season following overstory removal.
- In the Penticton Forest District, 1-year-old sprouts average 40 cm in height on moisture-deficient sites and 95 cm in height on sites with moisture available all year.
- Residual aspen left standing after logging of a dominantly coniferous stand will produce large numbers of suckers because of the resulting increased light and heat on the forest floor.

Manual Treatments

- Advance girdling of mature aspen in predominantly coniferous stands may be successful, provided the remaining conifers produce enough shade to retard suckering.
- If management objectives are to minimize the number of suckers produced per treated stem, it is better to girdle aspen than to cut it down. Cut trees can produce more than twice as many suckers as girdled trees. Girdling of a 55-year-old pure aspen stand resulted in 1910 stems per hectare after 4 years. Sucker density on an adjacent cut area was 32 617 stems per hectare.
- Most girdled trees die within 1–3 years.
- Manual cuttings are not recommended for reducing the frequency or cover of young aspen suckers that develop following logging or site preparation.
- Cutting at any time of year results in rapid regrowth of root suckers. Suckers grew 0.5–1 m in height in the first growing season in the ICHmw subzone.
- The number of suckers rapidly declines over time as a result of self-thinning and other damaging factors.
- Studies of the effect of season of treatment on aspen suckering are contradictory. Girdling or cutting during the active growing season should minimize suckering.

- Regardless of method or season, manual cutting will result in an increase in the number of stems over pre-treatment levels.

Chemical Treatments

- Glyphosate applied as a foliar spray or as a hack-and-squirt treatment controls aspen.
- Mid- to late summer foliar sprays of glyphosate at 2.1 kg a.i./ha have provided excellent control with high mortality rates and little suckering.
- Fall applications of glyphosate have tended to be much less effective than summer applications.
- Pre-harvest hack-and squirt with glyphosate can be effective, but results are variable.
- This treatment is less effective on stems larger than 40 cm in diameter.
- Control following foliar applications of glyphosate is variable. Suckering has been reported within 3 years of treatment.
- Broadcast or spot applications of liquid or granular hexazinone control aspen, provided organic soil layers are not deep.
- Hack-and-squirt treatments with hexazinone should control aspen; results of hack-and-squirt treatments with 2,4-D have been variable.

Mechanical Site Preparation

- Mechanical treatments that expose mineral soil will stimulate suckering by increasing root temperatures.
- Seedling establishment is negligible even on moist mineral soil seedbeds.
- Mechanical site preparation will not be successful in reducing the frequency and cover of aspen unless severe treatments that remove the upper layer of soil are used.
- In northern Ontario, scarification of 1- to 4-year-old aspen suckers with shark fin barrels and anchor chain drags produced no significant reduction in aspen density.
- Intense 30 cm deep cultivation has significantly reduced suckering of aspen in the BWBS zone.
- To retard aspen growth for the establishment and growth of conifers, scarification should be carried out after the suckers have completed at least one season's growth. In contrast, to develop an aspen stand, scarification should be done within 1 year of harvest.

Prescribed Burning

- Moderate to severe burns will maximize the number of suckers produced unless the burn is so severe that root tissue is killed. A light burn that damages but does not kill standing aspen will produce the fewest suckers.
- Most suckers develop in the first-year following a burn.

- Sucker density begins to decrease and stabilize within about 4 years of burning.
- Frequent, repeated fires initially promote suckering but will eventually reduce the vigour of aspen suckering.
- Burned stumps are less likely to sprout than unburned stumps.

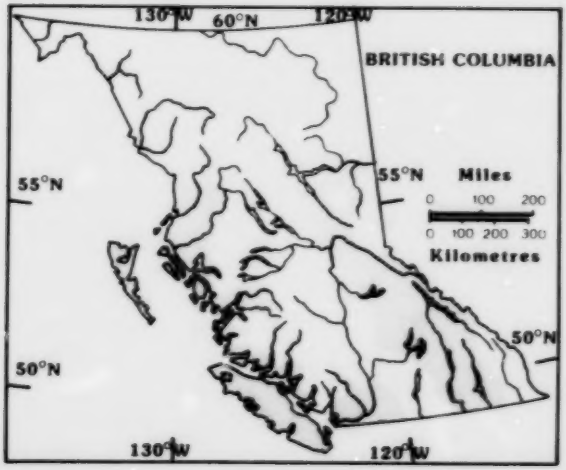
Other Treatments

- Burning of young aspen followed by a mid-summer spray of the resulting suckers with 2,4-D ester has provided better control than either burning or spraying alone.
- Aspen that is less than 1 m tall is not tolerant of sheep grazing. It can be virtually eliminated from a site after 3 years of heavy summer-long use.
- Cattle grazing does not severely retard aspen growth.

Wildlife and Range Values

- Trembling aspen is important to ungulates, small mammals and birds.
- The species is common winter and spring food for moose, mule deer and white-tailed deer and is a year-round food of Rocky Mountain elk.
- Trembling aspen is an important winter food for black-tailed deer, mountain goat, bighorn sheep, Roosevelt elk and caribou.
- Moose and elk damage aspen by feeding on the bark.
- Repeated browsing by moose has retarded height growth and increased stem density and biomass in the 0–3 m zone in which moose forage.
- Aspen clones provide cover and habitat for big game.
- Small mammals such as porcupines, mice and hares do considerable damage by feeding on the bark.
- Trembling aspen is an important winter food and habitat for snowshoe hares and ruffed grouse.
- Aspen provides nesting sites for many cavity-nesting birds.
- Aspen is preferred cattle forage in all seasons.

Pteridium aquilinum
(bracken)



Distribution of *P. aquilinum* in British Columbia.

Overstory Removal

- If bracken is present in the forest understory before harvesting, it will expand rapidly by rhizomatous growth.
- If bracken is not present in the understory before logging, colonies can quickly develop from germinating spores. Bracken will invade virtually any unoccupied habitat. Germination is favoured by high levels of disturbance and does not occur under established vegetation.
- Bracken may invade older clearcuts.
- Bracken cover can increase significantly following thinning of a conifer overstory. In the CDF zone on Vancouver Island, light thinning of Douglas-fir caused bracken biomass to increase by nearly 4 times, while heavy thinning increased bracken biomass by 8 times.
- Bracken usually dies back or loses vigour as the forest canopy closes in.

Manual Treatments

- Single manual cutting treatments are ineffective in controlling bracken.
- Bracken sends up new fronds following cutting.
- Bracken can be cut many times in one growing season and will still produce new fronds the next year.
- Repeated cutting at relatively short intervals over a period of several years can provide successful control.

Chemical Treatments

- Chemicals must act on the rhizome system to be effective.
- All of the chemicals currently registered for use in B.C. provide only short-term control because they do not kill the extensive root system.
- Most literature cites asulam as the most effective herbicide for killing bracken without damaging crop trees.
- Asulam applied at rates of 2–6 kg a.i./ha is reported to kill bracken. Operational applications of asulam betwen July and September in coastal B.C. has controlled bracken.
- Glyphosate may be marginally more effective than asulam in some situations, but success has been variable. In Washington and Oregon, late summer applications are very effective whereas fall applications cause only moderate injury. In coastal B.C., operational use of glyphosate in late summer has produced good control. Some trials report top-kill followed by sprouting the next year, but in the U.S. Inland Northwest, top-kill in the second season is usually over 80% after application rates greater than 1.1 kg a.i./ha.

- 2,4-D applied in winter causes moderate injury, while spring and summer applications are ineffective in western Washington and Oregon.

Mechanical Site Preparation

- Most mechanical treatments maintain or increase the frequency and cover of bracken.
- Damage to the rhizome system stimulates sprouting; fragmentation creates new plants.
- Repeated deep plowing or discing can be effective, but may not work in areas of high summer rainfall.

Prescribed Burning

- Bracken sprouts vigorously following fire and rapidly returns to, or exceeds, pre-burn levels.
- Bracken expands into vacant areas created by burning; burned soil is an ideal substrate for spore germination.
- Bracken will continue to increase in frequency and cover until it is overtopped by other species.

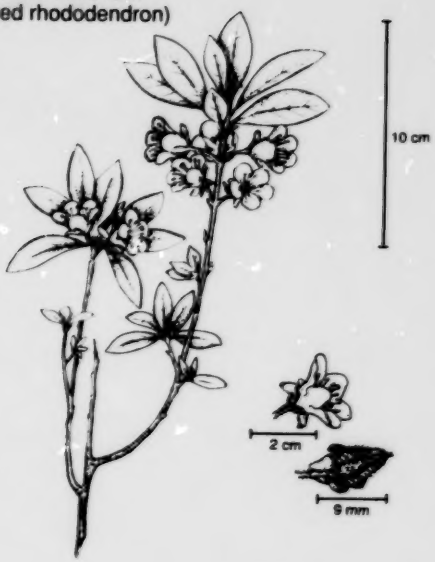
Other Treatments

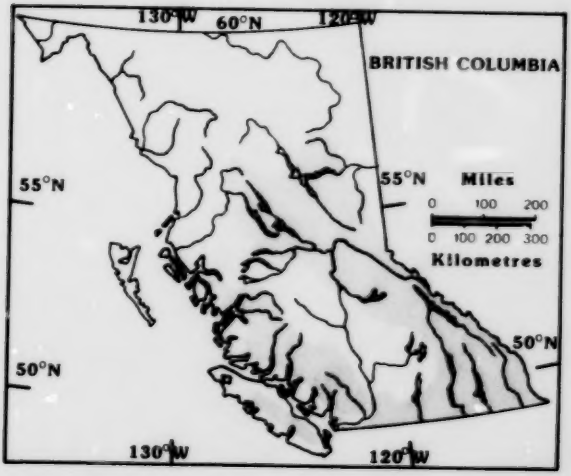
- Trampling by cattle is widely used as a means of control in agricultural areas.
- Bracken responds to fertilization with increased sprouting and rhizome growth. When present in the understory of fertilized Douglas-fir stands, it will tie up some of the nitrogen, but this is not seen as a problem unless soils are very nitrogen-deficient.

Wildlife and Range Values

- Bracken is an important food for all deer species in B.C., as well as for blue grouse and, in Washington and Oregon, mountain beaver.
- Roosevelt elk and caribou also use bracken.
- Mountain beaver often use bracken for their nests. Mountain beaver are common in the U.S. Pacific Northwest but occupy a limited range in B.C.
- Bracken is toxic to cattle.

Rhododendron albiflorum
(white-flowered rhododendron)





Distribution of *R. albiflorum* in British Columbia.

Overstory Removal

- Major changes in cover are not expected following winter logging on snow which does not damage plants. Individual plants will increase somewhat in size and vigour.
- Summer logging disturbs the soil and tends to break and uproot rhododendron plants, setting them back for several years, and resulting in replacement by perennial herbs such as *Valeriana sitchensis* and *Epilobium angustifolium*.

Manual Treatments

- A study involving manual cutting in early July on a zonal ESSFwc site near Clearwater, B.C., showed that:
  1. Regrowth after cutting is slow. One growing season after cutting, rhododendron grew only 2 cm in height.
  2. Height growth increased after the first growing season. Second-year height growth was up to 5 times greater than first-year height growth.
  3. New shoots were produced on 63% of cut stems. There were about three shoots per stem on sprouting stems.
  4. Second cuts did not appear to affect regrowth vigour.
  5. Three years after cutting, clipped plants appeared to have more leaves per unit length of stem than unclipped plants.

Chemical Treatments

- Rhododendron has been highly susceptible to foliar applications of glyphosate at 1.4–2.1 kg a.i./ha.
- Glyphosate provides at least 3 years of control.
- Glyphosate appears to translocate poorly; only those plant portions that are sprayed die.
- Garlon® may be more effective than glyphosate.

Mechanical Site Preparation

- Recovery from treatments that physically uproot the plant will probably be slow.
- Intense mechanical site preparation controls rhododendron for at least 10–15 years in the ESSF zone in the southern Interior of B.C.
- Seedling establishment on areas of exposed mineral soil is insignificant.

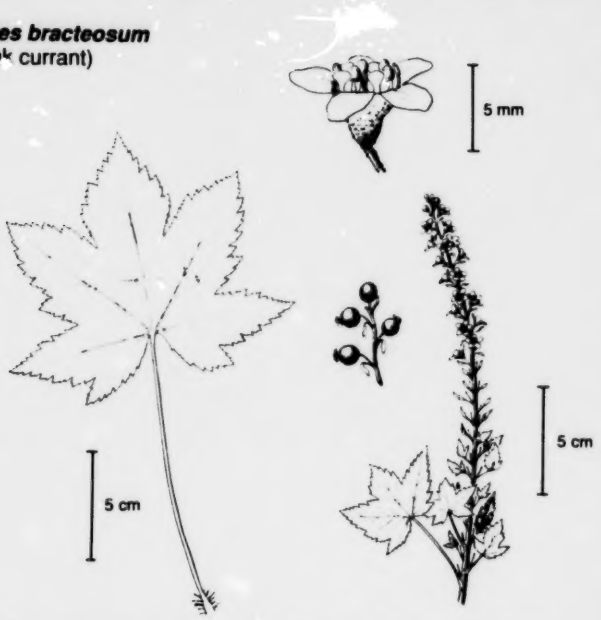
Prescribed Burning

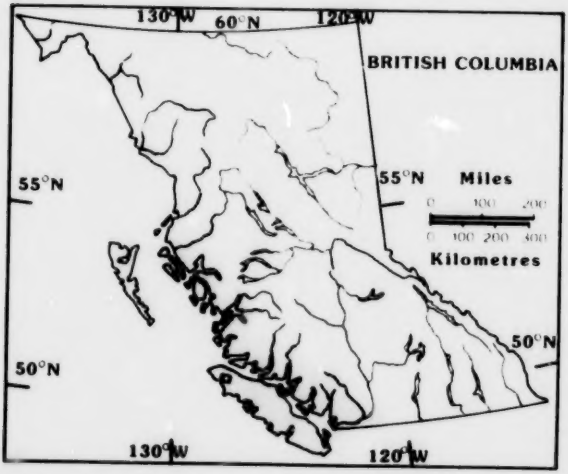
- Moderate to severe fires will set back rhododendron for up to 15 years.

Wildlife and Range Values

- Rhododendron is unpalatable to livestock and wildlife.

Ribes bracteosum
(stink currant)





Distribution of *R. bracteosum* in British Columbia.

Overstory Removal

- Stink currant apparently goes through an initial period of shock immediately following canopy removal. After recovery, it increases significantly in cover, but rarely in height.
- The number of stems may increase slowly by seeding-in and layering.
- Soil disturbance associated with logging does not appear to affect stink currant response.

Manual Treatments

- Stink currant sprouts rapidly following cutting and can return to pre-treatment levels within 1 year.

Chemical Treatments

- 2,4-D and glyphosate will usually kill the aerial parts of stink currant. Most plants will resprout.
- Stink currant is thought to be more resistant to the registered chemicals than associated *Rubus* species with which it is usually found.

Mechanical Site Preparation

- Currants are seed-banking species, and removal of other vegetation may create favourable conditions for germination of stored seed.
- Expect damaged stems to sprout back.

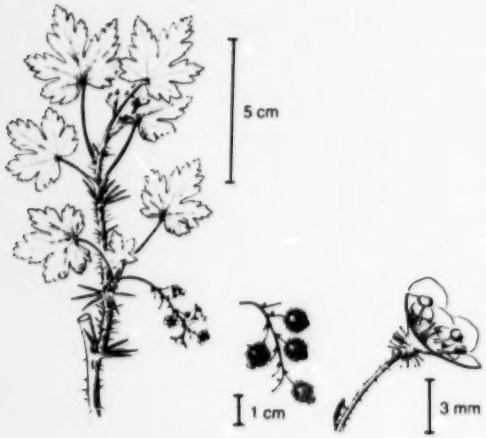
Prescribed Burning

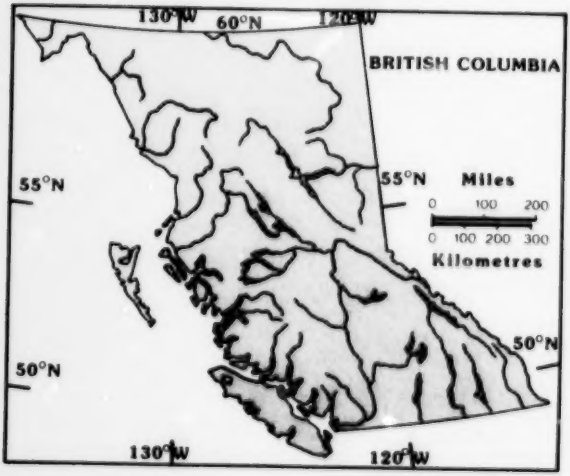
- Stink currant sprouts back after fire. It takes 1–3 years to return to pre-treatment levels.

Wildlife Values

- Stink currant is a moderately important winter browse for black-tailed deer and Roosevelt elk.
- Bears and many bird species eat the fruit.

Ribes lacustre
(black gooseberry)





Distribution of *R. lacustre* in British Columbia.

Overstory Removal
- Abundance and vigour usually increase following canopy removal, but high percent covers are seldom attained.

Manual Treatments
- Expect gooseberry to sprout from root collars following cutting.

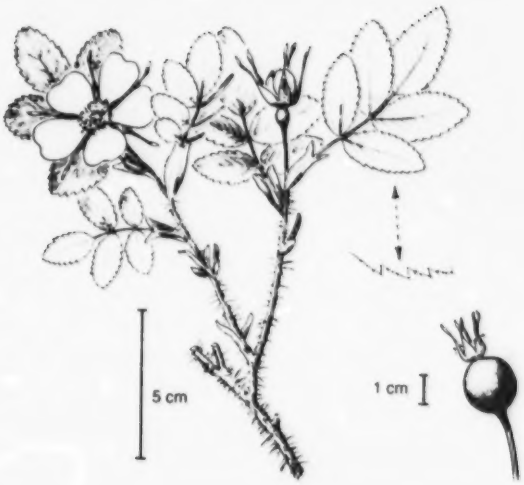
Chemical Treatments
- Late summer and early fall applications of glyphosate have provided moderate to good control of gooseberry.
- Limited information suggests that hexazinone can provide moderate to good control.
- Fall foliar applications of 2,4-D ester in oil and water have resulted in moderate injury to gooseberry in Washington and Oregon.

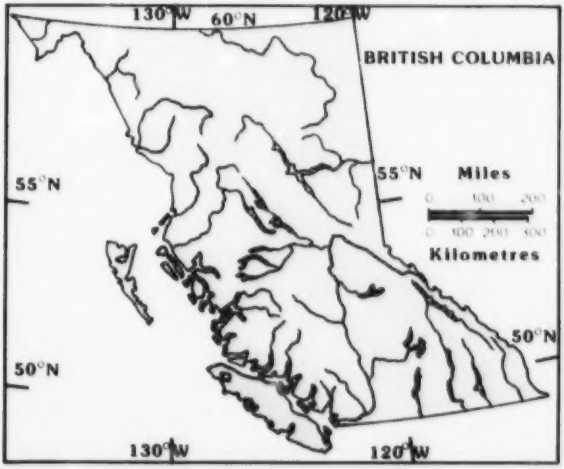
Mechanical Site Preparation
- Abundance may slightly increase after treatment until taller vegetation shades it out.

Prescribed Burning
- Burning usually increases abundance of gooseberry, but not to levels that are a serious threat to conifers.
- Light fires increase gooseberry cover through sprouting from surviving rhizomes and root crowns, and through germination of banked seed and seed-imported by birds.
- Severe fires that remove the organic layer destroy buried seed and kill plants.

Wildlife Values
- Most animals feed on the berries rather than the leaves or the stems.
- Many bird species, bears, and some small mammals such as squirrels and skunks consume the fruit.
- The species is a moderately important winter food of Roosevelt elk and black-tailed deer and a moderately important summer and fall food of moose and mule deer.
- Seed dissemination (and perhaps germination) is facilitated by passage of seeds through the digestive tract of birds and mammals.

Rosa
(roses)





Distribution of *Rosa* in British Columbia.

Overstory Removal
- Forest canopy removal does not result in a dramatic change in rose cover.
- Rose decreases in abundance immediately following disturbance while invading herbaceous species dominate, and regains its pre-disturbance cover after several growing seasons.
- Cover may not increase until canopy closure.

Manual Treatments
- Sprouting can occur in the same growing season as cutting.
- Recovery from cutting occurs at a moderate rate; pre-cut height and cover was regained within 5 years in Idaho.

Chemical Treatments
- Glyphosate applied as a foliar spray controls roses. Spring and fall applications cause at least moderate injury, and generally severe or very severe injury.
- Hexazinone effectively controls roses when applied by liquid spray, liquid spot, or granular broadcast methods. Spring applications and spot methods provide the best control.
- 2,4-D applied in spring or fall has seriously injured roses, but results have been variable.

Mechanical Site Preparation
- Roses sprout from rhizomes and root crowns damaged during mechanical site preparation.
- Expect moderately vigorous sprouting after mechanical treatments.

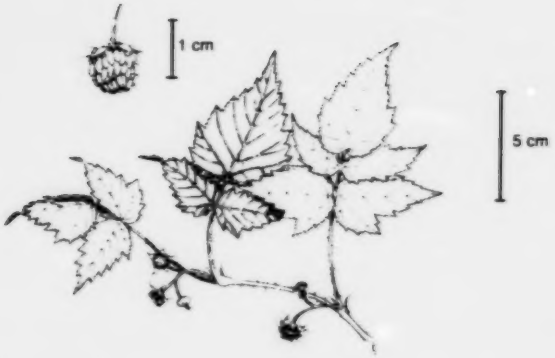
Prescribed Burning
- Fires generally do not cause a substantial change in rose cover unless they are severe enough to kill the shallow root crowns.
- Sprouting from undamaged or buried root crowns and rhizomes allows roses to persist or increase after light to moderate fires. Roses also regain cover after light to moderate fires through the germination of buried or transported seed.
- Multiple burns can significantly reduce rose cover.

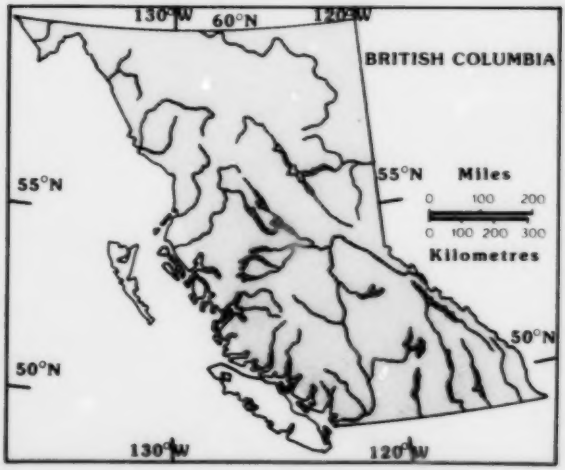
Wildlife and Range Values
- Roses are a preferred browse of ungulates in B.C.
- Roses are browsed in all seasons by elk, deer, moose, caribou and bighorn sheep in all seasons.
- Fruit, twigs and foliage are used by many birds and small mammals including blue grouse, squirrels, pika, mice, porcupines, beaver and snowshoe hares.
- Spring and fall burning generally increases stem and leaf productivity and foliar nutrient concentrations of roses, thus improving their forage value.

ROSES

- Rose thickets are used for nesting and provide escape cover for birds and mammals.
- Cattle have a medium to high preference for grazing roses. Use of the plants is probably highest in late summer and fall.
- Vigour is reduced by browsing early in the growing season when root carbohydrate reserves are low. Recovery is faster from late-season grazing.

Rubus idaeus
(red raspberry)





Distribution of *R. idaeus* in British Columbia.

Overstory Removal

- Red raspberry is usually absent from closed forests, but it can occur in open forests.
- Overstory removal can increase the cover of the species.
- Raspberry frequently does not become established until 3–5 years after harvesting. If the site is quickly taken over by other species during this time, it will not be able to compete.

Manual Treatments

- Raspberry canes have a 2-year lifespan; manual treatments will not have a lasting effect unless they are repeated at frequent intervals.
- Cutting stimulates both basal sprouting and root suckering.
- Cutting increases the vigour of vegetative growth for the first growing season.
- Complete recovery from cutting can occur within one growing season.

Chemical Treatments

- Red raspberry is tolerant of 2,4-D.
- Results with glyphosate have been variable. Results range from top-kill followed by sprouting and suckering to total mortality. Rates of about 2 kg a.i./ha cause a moderate reduction in raspberry after the first growing season, full recovery after the second growing season, and an increase over pre-treatment cover after the third growing season.
- Red raspberry may be quite sensitive to hexazinone at rates of 2–5 kg a.i./ha.
- Raspberry may invade openings where other species have been removed by herbicides.

Mechanical Site Preparation

- Most mechanical treatments will probably increase raspberry abundance.
- Invasion is particularly intense in heavily disturbed areas such as landing piles and roadsides.
- Raspberry seed readily germinates on exposed mineral soil where there is little competition from other plant species.
- Fragmentation of the root and rhizome system produces new plants.

Prescribed Burning

- Red raspberry is usually more abundant on burned areas than on unburned areas.
- The plant can become very abundant on mineral soil created by a hot burn.

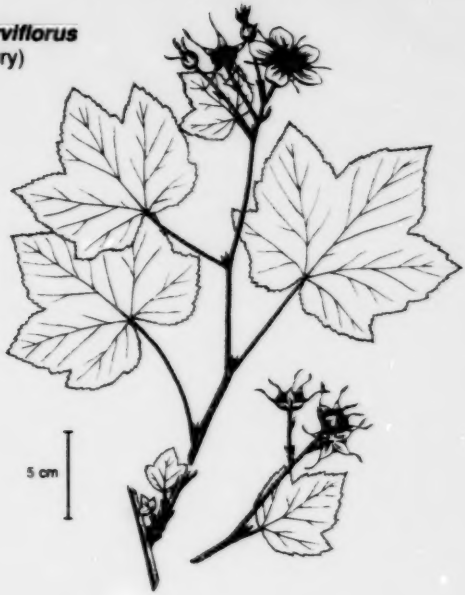
RED RASPBERRY

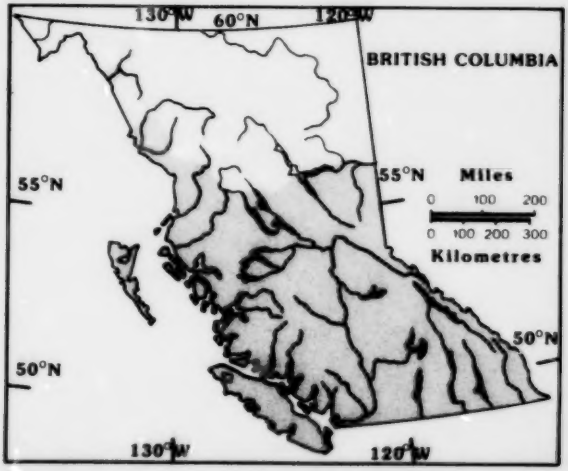
- Burning stimulates sprouting and suckering of existing plants, stimulates germination of buried seed, and provides a suitable seedbed for germination of newly deposited seed. The absence of competing plants immediately following fire also favours raspberry expansion.
- Raspberry is shade intolerant and can be shaded out by other plants within 3–5 years of burning.
- Vegetative parts of red raspberry are thought to be very resistant to heat damage.

Wildlife Values

- Berries are a favourite summer food of wildlife.
- The berries are important to many game and song birds and are also consumed by small mammals such as skunks, racoons, chipmunks, squirrels and mice.
- Deer and rabbits use leaves and stems extensively.
- Bears forage on the fruit.

Rubus parviflorus
(thimbleberry)





Distribution of *R. parviflorus* in British Columbia.

Overstory Removal

- On areas where thimbleberry is present before harvesting it will rapidly increase in frequency, cover and vigour.
- Thimbleberry can double or triple its cover in 5 years after overstory removal.
- Aboveground biomass of thimbleberry approximately doubled 1 year after mortality of a girdled alder overstory in the CWH zone in the Kitimat Valley.
- Increases in thimbleberry are due to a combination of sprouting, suckering and seedling establishment, but resprouting from existing rhizomes is the primary mode of reproduction.
- Thimbleberry does not normally invade ecosystems that are significantly drier and poorer than those where it is present under the forest canopy.
- Cover declines as canopy cover increases.

Manual Treatments

- Manual treatments are not considered an effective means of reducing the frequency and cover of thimbleberry.
- Rapid sprouting and suckering follow cutting.
- In an Oregon study, thimbleberry grew 75–100 cm in the first year following cutting regardless of the cutting season (dormant, early summer, late summer).
- The density and leaf area of the thimbleberry canopy increases following cutting.
- Thimbleberry can be cut two or three times in one growing season and will still come back the following year.
- Height and cover often equals or exceeds pre-treatment levels 1–2 years after cutting.

Chemical Treatments

- Foliar applications of 1.5–2.1 kg a.i./ha glyphosate in late summer have consistently provided extensive top-kill, but most plants rapidly resprout.
- June and July applications of glyphosate have tended to provide only partial control of the species.
- 2,4-D has provided variable but generally unsatisfactory control of thimbleberry.
- Hexazinone tends to be ineffective for thimbleberry control because of high organic matter levels in soils where the plant grows.
- Hexazinone has caused mild to moderate injury, but plants recover quickly.
- Thimbleberry is partially tolerant of late summer applications of triclopyr ester. Greater levels of control are achieved with mid-summer applications of triclopyr.

THIMBLEBERRY

- Amitrol applied in the spring or summer has caused moderate injury to thimbleberry in western Washington and Oregon.

Mechanical Site Preparation

- Thimbleberry rapidly invades areas of disturbed soil and can increase following scarification.
- Soil disturbance stimulates germination of stored seed and provides a suitable seedbed for freshly deposited seed.
- Plants damaged by mechanical treatments will rapidly sprout or sucker.
- Thimbleberry often regains pre-treatment levels within 3 years of mechanical site preparation.

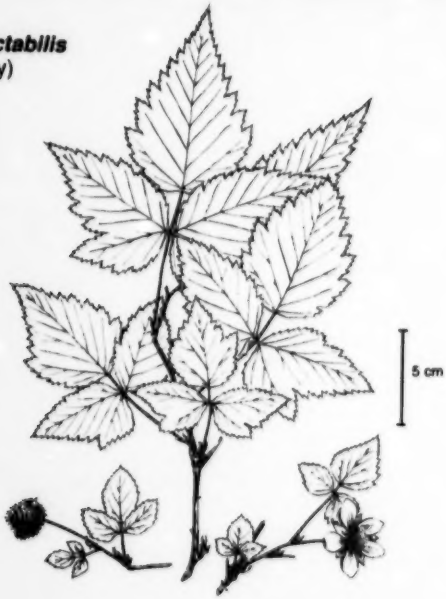
Prescribed Burning

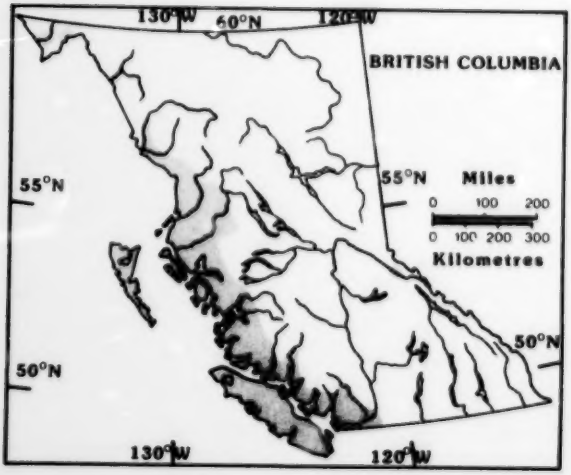
- Vigour can be reduced and recovery can be slow after severe burns.
- Low severity burns stimulate germination of buried seeds and result in rapid sprouting and suckering. Recovery from low severity burns can occur in 1–2 years.
- Burning can reduce thimbleberry abundance on mesic ecosystems or sites with coarse soil textures where heat from the fire is effectively transmitted to the roots.
- Early dominance of burned sites by aggressive species such as fireweed may delay development of thimbleberry cover.

Wildlife Values

- Thimbleberry is a moderately important food for black-tailed deer which eat the fruit, leaves and stems.
- Thimbleberry is a common summer food for mule deer.
- Thimbleberry has moderate to low importance as winter and spring forage for Roosevelt elk.
- Bears feed on the young shoots.
- The fruit is favoured by many birds and mammals.

Rubus spectabilis
(salmonberry)





Distribution of *R. spectabilis* in British Columbia.

Overstory Removal

- In areas where salmonberry is present before harvesting, it will rapidly expand in frequency and cover following overstory removal.
- Aboveground biomass can double within 1 year of overstory removal.
- Salmonberry can reach 100% cover 1 or 2 years following harvesting.
- Expansion is primarily by means of rhizomatous suckers and germination of buried seed.
- Where salmonberry is not present before logging, it can invade areas of disturbed soil with seed carried in by animals or by germination of buried seed.
- Salmonberry can increase significantly following thinning of conifer stands.

Manual Treatments

- Manual treatments are not a viable method of reducing salmonberry frequency or cover.
- Salmonberry rapidly sprouts and suckers following cutting, growing up to 1 m in height by the end of the following growing season.
- Stem density and leaf area increase after cutting.
- Most stems produce two or three sprouts. Season of cutting apparently has no effect on the vigour and number of sprouts produced.
- In an Oregon study, growth of sprouts was significantly less on stems cut early in the growing season than on those cut when dormant. However, neither treatment succeeded in reducing competitive stress on conifers.
- Multiple cuttings in one growing season do not appear to reduce the vigour of vegetative reproduction the following year.

Chemical Treatments

- Glyphosate applied as a foliar spray at 1.0–2.1 kg a.i./ha provided excellent control of salmonberry. All aboveground parts are killed and little subsequent sprouting or suckering occurs. Vegetation control declines 2 or 3 years after glyphosate is applied.
- Salmonberry is more sensitive to late foliar sprays than to early foliar sprays of glyphosate.
- An Oregon study found that plants damaged during logging were less susceptible to glyphosate than undamaged plants.
- Broadcast applications of hexazinone have tended to be ineffective in controlling salmonberry because of high organic levels in soils where the plant grows.
- 2,4-D has caused light to moderate damage to salmonberry.

SALMONBERRY

- Salmonberry is partially tolerant of late summer applications of triclopyr ester. Greater levels of control are achieved with mid-summer applications of this herbicide.
- Amitrol causes severe injury to salmonberry when applied in spring and moderate injury when applied in summer in western Washington and Oregon.

Mechanical Site Preparation

- Unless it is severe enough to remove surficial soil layers, mechanical site preparation will probably increase the frequency of salmonberry.
- Damaged or flattened stems can sprout, sucker or layer.
- Stem fragments incorporated into the soil frequently root and produce new colonies.
- Exposure of mineral soil can stimulate germination of buried seed.

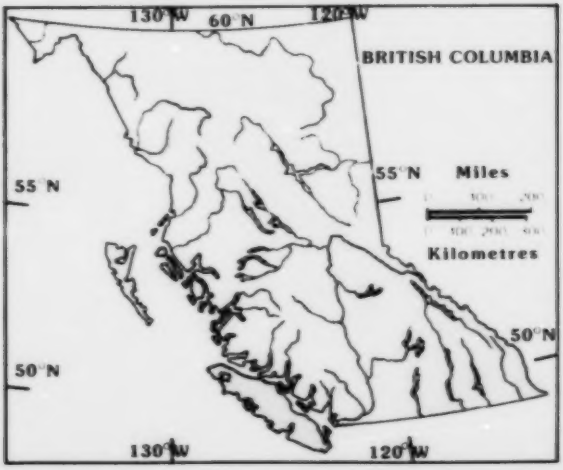
Prescribed Burning

- Germination is similar on burned and unburned sites.
- Fire can be successfully used to control salmonberry expansion on mesic ecosystems or on sites with coarse-textured soils where heat from the fire is effectively transmitted downwards to kill the root system and destroy stored seed. However, site fertility may be reduced by severe fires.
- Salmonberry can rapidly increase in cover by sprouting following light or moderate severity fires.

Wildlife Values

- Salmonberry is an important food for Roosevelt elk and black-tailed deer, especially during winter and spring.
- Shoots may be a very important spring forage for black and grizzly bears and the berries are a favourite late spring food of bears.
- Birds and small mammals consume salmonberries and use the plant for cover.

Salix bebbiana
(Bebb's willows)



Distribution of willows (*Salix* spp.) in British Columbia.

There are many different species of willow on forested sites in British Columbia. Responses to silvicultural practices can vary a great deal between species and even within species. The following are generalized comments relating to the typical behaviour of some common willow species.

Overstory Removal

- Increased sunlight following overstory removal is very favourable to willow.
- Frequency and cover generally increase following harvesting. The increase is usually slow unless soil disturbance and damage to existing plants has been extensive.
- Individual plants fill out and become much larger following release.

Manual Treatments

- Manual treatments are usually used to increase production of willow browse and are not considered to be an effective means of reducing frequency and cover.
- Willow will sprout vigorously when cut, regardless of cutting season. Plants cut during the dormant season sprout most vigorously.
- The number of sprouts per cut stem can vary from only 1 or 2 to as many as 60.
- Willow sprouts can grow 2–3 m in the first growing season. Willows cut in July can produce sprouts that are 1 m tall by the end of that growing season. Willows cut in June have produced sprouts up to 2 m tall at the end of the growing season.
- The rapid growth of willow allows it to overtop other species following manual cutting.
- Girdling has resulted in prolific basal sprouting.

Chemical Treatments

- Chemical treatments have produced variable results. One reason for this may be the difficulty of identifying individual willow species.
- 2,4-D ester as an early foliar treatment at 3 kg a.i./ha has provided good control in the Vancouver Forest Region.
- Application of 2,4-D amine to cut surfaces in spring or late summer has resulted in very severe injury to willow in Washington and Oregon.
- Fall applications of glyphosate to cut surfaces effectively controls willow.
- Late summer and fall foliar applications of glyphosate produces high rates of defoliation, but treatments are generally followed by sprouting.
- May and June foliar applications of 2–4 kg a.i./ha of hexazinone have resulted in poor to excellent control of willow; depth of the

organic layer does not explain the variability in results. Control is best at the higher applicatica rates.
- Spot applications of hexazinone provide excellent first-year control of willow when applied in any month between May and October.
- Spot applications of hexazinone can control willow for at least 4 years.
- Expect low spot application rates of hexazinone (e.g., 4 mL per spot at 2 x 2 m spacing) to provide unsatisfactory first-year control of willow. Spot applications of hexazinone can control willow for at least 4 years.

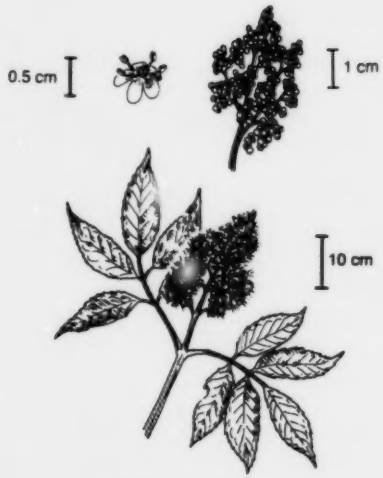
Mechanical Site Preparation
- Mechanical treatments are likely to increase the abundance of willows on a site.
- Damaged stems will sprout, broken and buried branch parts may root, and seedling establishment is favoured by mineral soil.
- Willow can rapidly invade exposed mineral soil after scarification and densely overtop planted conifers.

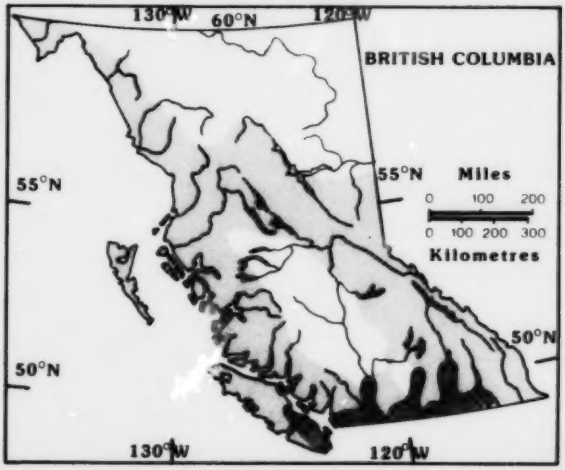
Prescribed Burning
- Aerial parts of willows are easily killed by fire.
- Willows sprout following fire, and burning usually increases willow cover within a few years.
- In a Montana study, willow cover increased more than 10-fold the first year after burning, and more than 30-fold the second year.
- The vigour and intensity of sprouting may be affected by the intensity and duration of the burn. Quick, hot fires appear to maximize sprouting, while slower, longer burns cause more extensive damage.
- Height growth of willow developing from seed was 5 times greater on severely burned compared to lightly burned microsites 6 years after a burn in Alaska.
- Eradication of willows through fire is highly unlikely; willows have been known to survive even the most severe forest fires.
- Expect variable levels of sprouting following burning.

Wildlife and Range Values
- Willows are the staple food of moose and are important year-round.
- Moose browse on twigs in winter and consume leaves and new shoots in summer.
- Palatability to wildlife is highly variable within the willow genus. Dryland willows are very palatable; wetland willows are less so.
- Willows are a prime summer and winter food for deer and have moderate importance as winter and spring food for elk.
- Shoots, buds and catkins are eaten by many rodents, other small mammals, and birds.

- Willow is an important forage for snowshoe hare.
- Willow stands are valuable habitat for wildlife.
- Riparian willow stands provide winter range for moose; maximum use occurs from mid- to late winter and during months of the greatest snow depths.
- Willow thickets are important habitat for birds and some small mammals (e.g., snowshoe hare).
- Many species of birds nest in willow.
- Cattle have medium to high preference for grazing willow.

Sambucus racemosa
(red elderberry)





Distribution of elderberries (*Sambucus* ssp.) in British Columbia. The shaded area represents the distribution of *S. racemosa*, while the hatched area shows the distribution of *S. cerulea*.

Overstory Removal

- Frequency and cover of elderberry either remains constant or increases following canopy removal. No studies have reported a dramatic increase in elderberry abundance.
- Individual plants fill out and produce a broad, spreading crown; plants can become extremely vigorous following overstory removal.
- In an Oregon study, prolific seedlings have been reported 1 year following logging. In this case the seedlings were attributed to a large flock of pigeons distributing seeds in the area. Seed stored in the forest floor may also be stimulated to germinate by canopy removal and logging disturbance.

Manual Treatments

- Rapid sprouting follows cutting. Some plants also produce rhizome suckers.
- A sprout can grow up to 75% of its full height in the first growing season after cutting. Elderberry is considered to be one of the fastest sprouting species (in terms of sprout height and vigour) in the Pacific Northwest states.
- Two to five sprouts are typically produced for each cut stem. In Oregon, cutting during dormancy or early in the summer produces fewer sprouts than late summer cutting.
- The plant cannot withstand repeated heavy clipping, but the potential for regrowth is not affected when cutting occurs only once at the end of each growing season.

Chemical Treatments

- Glyphosate is considered more reliable than hexazinone or 2,4-D for controlling elderberry. Injury is usually severe with late summer or fall applications at 2.1 kg a.i./ha, but control does not usually last. Sprouting often occurs by the second growing season.
- 2,4-D can kill elderberry, but it does not provide reliable control. Winter, spring and summer applications have caused moderate injury to elderberry in western Washington and Oregon.
- Limited information indicates that elderberry is extremely susceptible to amitrol.

Mechanical Site Preparation

- Mechanical treatments must uproot plants to provide effective control.
- An Oregon study reported more than 50% mortality following brush blade scarification. Some injured plants sprouted.
- Damaged stems and rhizomes sprout vigorously.
- Soil disturbance provides a suitable seedbed for germination of elderberry seedlings, and may stimulate germination of stored seed.

ELDERBERRIES

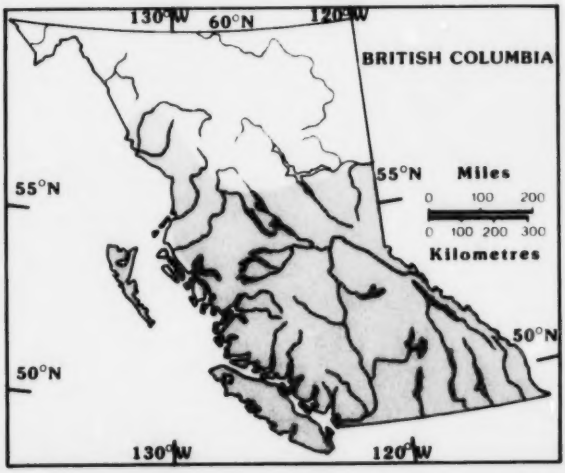
Prescribed Burning

- Elderberry will sprout back following fire unless fires are severe enough to kill the root system.
- Fire can stimulate germination of stored seed.
- Variable changes in cover and frequency have been reported following fire.

Wildlife Values

- Elderberry is a relatively important food for ungulates in B.C.
- The shrub is an important winter food of Roosevelt elk, a moderately important winter and spring food of Rocky Mountain elk and Columbia black-tailed deer, and a common summer food of all deer species in B.C.
- Browsing increases plant density.
- Moose, deer, elk and porcupine nibble on the buds and bark.
- The berries are a very important food of grizzly and black bears, many small mammals, and birds, especially band-tailed pigeon.
- The plant provides nest sites for birds.
- Elderberry is highly palatable to cattle in southeastern B.C.

Symphoricarpos albus
(snowberry)



Distribution of *S. albus* in British Columbia.

Overstory Removal

- Snowberry increases in both frequency and cover following harvesting. The increase can be slight or dramatic depending on local conditions.
- Increases in abundance occur through suckering, and germination of buried or fresh seed.

Manual Treatments

- Snowberry is a rhizomatous species that suckers and sprouts from roots and rhizomes in response to cutting.
- There are no reports of basal sprouting.

Chemical Treatments

- Glyphosate at 2.1 kg a.i./ha has caused high rates of injury and mortality when applied in the spring, late summer, or fall. Control appears to last for several years.
- 2,4-D ester at 3 kg a.i./ha applied as an early foliar spray has provided excellent control. Results with 2,4-D are poor to moderate when spraying takes place at other times of the year.

Mechanical Site Preparation

- Snowberry is a seed-banking species and stored seed can germinate following mineral soil disturbance.
- Plants damaged during mechanical treatments are likely to sucker.

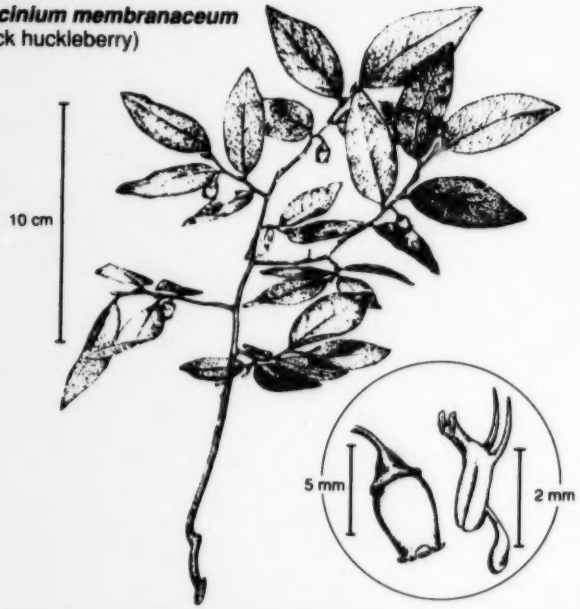
Prescribed Burning

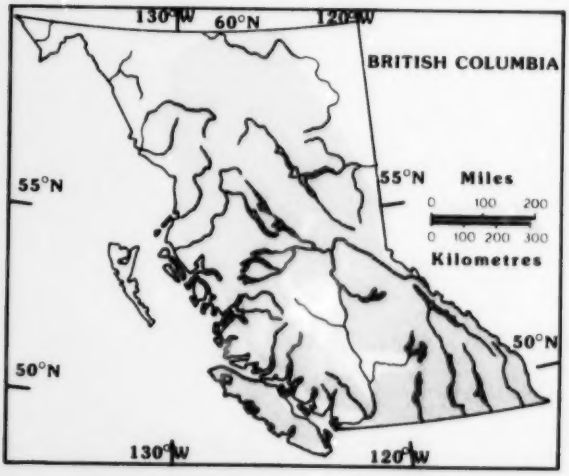
- Expect snowberry to increase in density after most fires.
- Snowberry regenerates from roots and rhizomes following low and moderate severity fires. Stem density usually exceeds pre-burn levels within 3–5 years.
- Severe fires that kill the deep root and rhizome system reduce suckering.
- Regeneration from buried seed is favoured by fires of low severity and short duration that remove little of the soil organic layer.

Wildlife and Range Values

- Snowberry provides browse to ungulates in the interior of B.C.
- The shrub is moderately important browse during summer, fall and winter for mule deer, white-tailed deer and Rocky Mountain elk.
- Use by deer in winter is low in some areas because snow buries the plants.
- Birds eat the berries in winter, but apparently they are not a preferred food.
- Snowberry provides cover and nesting sites for birds.
- Snowberry is commonly grazed by cattle, but withstands grazing well.

Vaccinium membranaceum
(black huckleberry)





Distribution of *V. membranaceum* in British Columbia.

Vaccinium membranaceum **BLACK HUCKLEBERRY**
Dougl.

Overstory Removal
- Abundance remains static or increases slowly following canopy removal.
- Plants become more vigorous and berry production increases.
- Expansion of huckleberry patches takes place through rhizomatous growth.
- Seedling establishment is uncommon.

Manual Treatments
- Sprouting and suckering occur after manual cutting; sprouting is not vigorous.
- Shrubs may take 3–7 years to reach pre-treatment levels.
- The number and density of stems increases following cutting.
- Early July cutting of black huckleberry in the ESSFwc subzone near Clearwater, B.C., resulted in:
  1. Average first-year height growth of 8 cm.
  2. Sprouts on 78% of original stems after the first growing season.
  3. An average of 3.3 shoots per stem on sprouting shoots.

Chemical Treatments
- Black huckleberry is usually resistant to glyphosate, but control has sometimes been effective, especially at maximum application rates.
- 2,4-D ester applied as an early foliar spray will kill aerial parts, but the plant will respond by sprouting the following growing season.
- 2,4-D amine can cause severe injury.
- Limited information indicates that hexazinone moderately damages black huckleberry.
- Simazine has minimal to moderate effect on black huckleberry.

Mechanical Site Preparation
- Black huckleberry does not readily invade areas of disturbed mineral soil.
- Most mechanical treatments are likely to result in a reduction in frequency and cover for several years. The species is effectively controlled with very little recovery for at least 5 years after mechanical site preparation in the wetter ICH and ESSF subzones.
- Discing apparently stimulates rhizome sprouting.
- In the ESSFwc subzone near Clearwater, B.C., scarification that removed tops of black huckleberry, or uprooted entire plants, produced the following results:
  1. There was no evidence of recovery after one growing season.
  2. Two growing seasons after disturbance, black huckleberry plants with surviving aerial stems were producing slow-growing new suckers.
  3. Few new shoots were produced by surviving plants.

BLACK HUCKLEBERRY

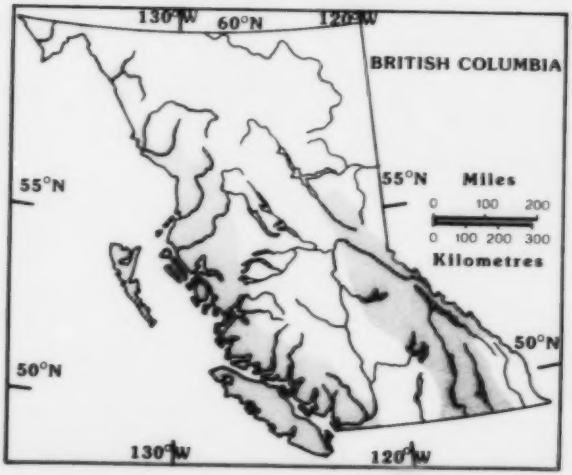
Prescribed Burning

- Black huckleberry sprouts and suckers following burns of light to moderate severity.
- Seedlings are not important in recolonizing burned sites.
- The number and density of stems can be expected to increase following light to moderate fires.
- Black huckleberry cover may return to pre-burn levels 3–5 years after light burns.
- Burns of moderate to severe intensity on coarse-textured soil or in areas with thin organic layers will cause heavy mortality by destroying the underground rhizomes. Recovery from intense burns can take 7 or more years.

Wildlife and Range Values

- The berries are prized by bears, small mammals, and many bird species.
- The berries are important for building up winter fat in black and grizzly bears and are therefore of high survival value.
- The twigs and foliage are foraged by bears, deer, foxes, rabbits, and many other small mammals.
- As winter and spring browse, black huckleberry has medium to high importance for black-tailed deer and medium importance for Roosevelt elk.
- As summer and fall browse, black huckleberry has medium to high importance for caribou, medium importance for black-tailed deer, and medium to low importance for mule deer and moose.

Vaccinium ovalifolium
(oval-leaved blueberry)



Distribution of *V. ovalifolium* in British Columbia.

Overstory Removal

- Oval-leaved blueberry remains at fairly constant levels following harvesting.
- Individual plants become more bushy and leaves become leathery with fewer leaves per stem.
- Cover and frequency can slowly increase over time until the shrub is overtopped by conifers.
- Some seeding-in will occur in open habitats.

Manual Treatments

- Early July cutting in the ESSFwc subzone near Clearwater, B.C., indicates that:
  1. Response to cutting is not vigorous. Height growth was about 6 cm/yr for the first two seasons after cutting.
  2. Most regrowth arose from sprouts on cut stems rather than from sprouts or suckers from the soil.
  3. After the first growing season, 50% of original stems sprouted, and stems that sprouted averaged three shoots per stem.
  4. Second cuts did not affect regrowth vigour.

Chemical Treatments

- 2,4-D may defoliate oval-leaved blueberry, but the plants will likely resprout.

Mechanical Site Preparation

- Oval-leaved blueberry does not invade areas of mineral soil disturbance. Best seedling establishment is on organic seedbeds.

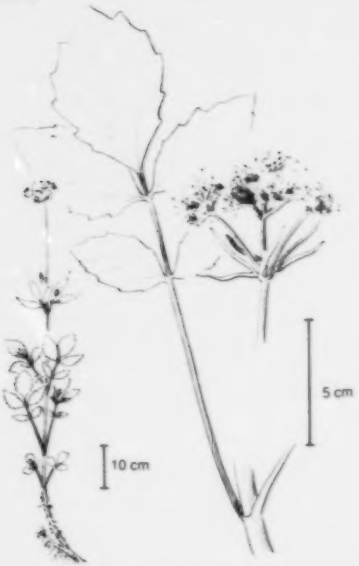
Prescribed Burning

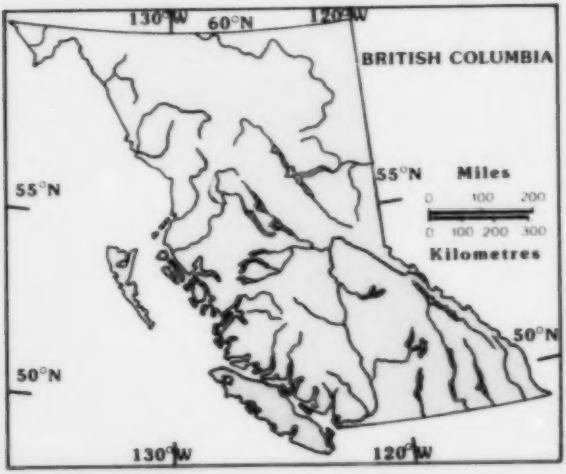
- Frequency and cover are thought to be significantly reduced following burning.
- Recovery following burning is primarily through vegetative reproduction, but expect regrowth to be quite slow.

Wildlife Values

- The berries are the most important plant part eaten, but leaves and twigs are also used.
- Oval-leaved blueberry is important forage for black-tailed deer during winter and spring, and a moderately important forage for this deer the rest of the year. It is moderately important to caribou during summer and fall and to elk during winter and spring.
- *Vaccinium* berries are a popular summer food and an important source of energy and fat deposition for grizzly and black bears, especially in the Interior.
- Many birds and small mammals favour the berries and disperse the seeds.

Valeriana sitchensis
(Sitka valerian)





Distribution of *V. sitchensis* in British Columbia.

Overstory Removal
- Expect an increase in vigour following canopy removal.

Manual Treatments
- Vigorous, sun-grown plants can achieve 1.5 times their original size within 6 weeks of cutting and completely recover vegetatively in the year they are cut.
- Shade-grown plants recover slowly from cutting.
- Multiple cuttings appear to decrease the vigour of Sitka valerian.

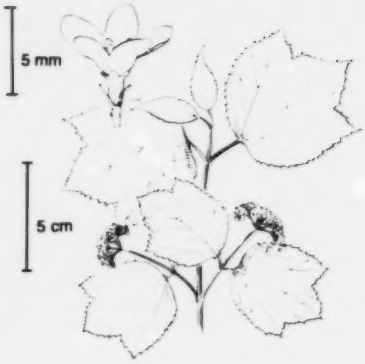
Chemical Treatments
- No information.

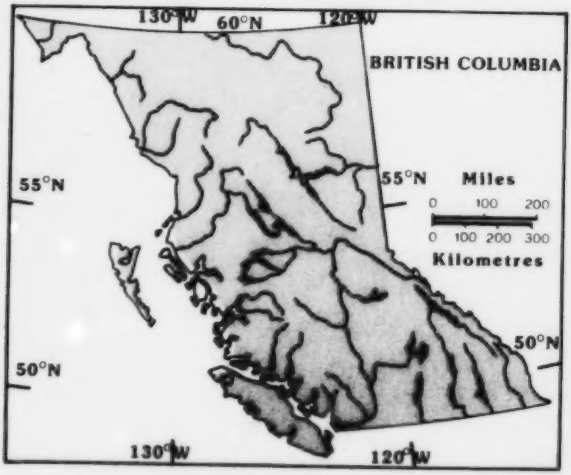
Mechanical Site Preparation
- Recovery to pre-treatment size occurs within one or two seasons of mechanical site preparation.

Prescribed Burning
- Expect Sitka valerian to recover quickly from light to moderate burns.

Wildlife and Range Values
- Sitka valerian is moderately used by wildlife as a summer food.
- Foliage is foraged by bear, mule deer, elk, caribou, bighorn sheep, mountain goat, marmot, fox, rabbit and pica.
- The species is a highly valuable summer and fall food for Rocky Mountain elk in the western United States and Canada.
- Sheep and cattle forage on the plant.

Viburnum edule
(highbush-cranberry)





Distribution of *V. edule* in British Columbia.

Overstory Removal
- The frequency and cover of highbush-cranberry remains constant or decreases slightly in the first few years following canopy removal.
- Expect plant vigour to increase on favourable habitats, but any increase in abundance occurs slowly.

Manual Treatments
- Expect sprouting following cutting. Regrowth is not vigorous.

Chemical Treatments
- Glyphosate defoliates cranberry and causes moderate rates of mortality.
- Limited information suggests that hexazinone is ineffective.

Mechanical Site Preparation
- This is a seed-banking species, and soil disturbance is expected to favour germination of stored seed.
- Mechanical treatments may also provide a favourable seedbed for germination of freshly deposited seed.
- Plants damaged or fragmented during site preparation can be expected to sprout back.

Prescribed Burning
- Fire promotes both vegetative reproduction and regeneration from seed.
- In Alaska, highbush-cranberry is one of the first species to sprout back following a fire.
- Fires of low severity and short duration that remove little of the organic layer should favour germination of buried seed.

Wildlife Values
- Highbush cranberry is a moderately important wildlife food.
- The fruit is more commonly consumed than the leaves or twigs.
- Highbush-cranberry is a preferred winter food for moose.
- Highbush-cranberry is a moderately important summer and fall food for Rocky Mountain elk, and a common winter food for white-tailed deer.
- Grizzly bears favour cranberry as a summer food.
- Rabbits and beaver browse on cranberry.

7 GLOSSARY

Allelopathy — The interference of one plant with the growth and development of another through chemicals produced by the plant and released into the environment.

Alluvial — Pertains to materials or processes associated with transportation or deposition by flowing water.

Autecology — The study of the adaptations and behaviour of individual species, populations or organisms in relation to their environment.

Berry — A fleshy fruit with more than one seed imbedded in pulpy tissue.

Biennial — Completing its life cycle in 2 years. Flowers and fruits are normally produced in the second year of a biennial life cycle.

Cane — A slender, normally short-lived, woody stem that usually arises directly from the ground.

Capsule — A dry, many-seeded fruit that splits open into several sections at maturity.

Clone — A group of plants propagated only by vegetative or asexual means. All members have been derived from a single individual and thus share the same genetic makeup.

Dehiscent — Splitting open along definite lines at maturity.

Ericaceous — Belonging to the Heather family (Ericaceae). Members of this family in British Columbia are typically acid-loving, fairly slow-growing, more-or-less woody plants with simple leaves and perfect (bisexual) flowers. This family includes such genera as *Vaccinium* (huckleberries, blueberries and cranberries), *Rhododendron* and *Menziesia* (false azalea).

Girdle — To cut away a ring of inner bark (cambium) completely encircling the stem of a plant so as to interrupt the translocation of carbohydrates through the plant.

Layering — A form of asexual (vegetative) reproduction in which a stem or branch still attached to the parent plant takes root, and eventually becomes a separate plant. Natural layering usually occurs when a branch comes into contact with moist soil or is buried in moist litter.

Nutlet — A small, hard indehiscent (non-opening) fruit containing a single seed.

Perennial — Continuing to grow year after year.

Rhizome — Any prostrate or underground stem, usually rooting at the nodes. Rhizomes may look very much like roots, but they are formed of stem tissue and thus possess a central pith.

Riparian — Situated along the bank of a river or other body of water.

Seed banker — A plant species whose reproductive strategy involves the production of long-lived seed that is stored in the forest floor until stimulated to germinate by a change in environmental conditions such as fire, increased light, or soil disturbance.

Seedling banker — A plant species whose reproductive strategy involves the production of shade-tolerant seedlings that persist in an extremely slow-growing state beneath an overstory canopy until overstory removal or other environmental change creates conditions favourable to growth and maturation of the seedling.

Sprout — An aerial shoot arising adventitiously or from dormant buds along the stem or at the base of the plant. Basal sprouts are those sprouts that arise at the base of a stem or from the root crown following damage to the parent plant. Stump sprouts are produced anywhere on a cut stump, usually from dormant buds or callus (wound) tissue.

Stolon — A trailing or reclining aboveground stem which forms roots and sends up new shoots where it touches the soil.

Sucker — A branch or shoot from a rhizome or root that ascends above ground. A sucker is distinguished from a sprout in that it is normally produced at some distance from the base of the parent plant, and tends eventually to become a separate plant.